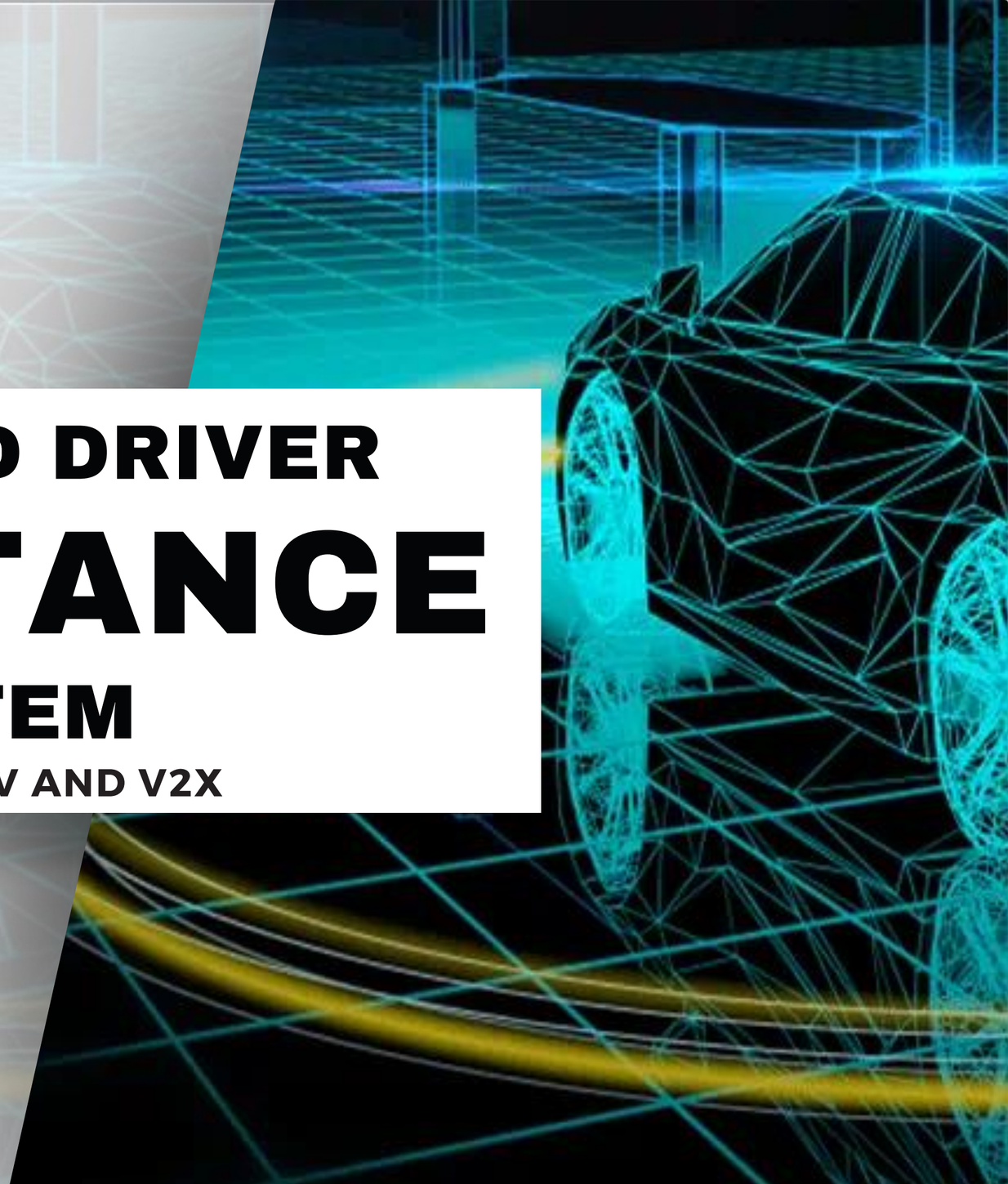
A1-Azhar university
Faculty of Engineering
Electronics & communication Department

ADVANCED DRIVER ASSISTANCE SYSTEM

BASED ON V2V AND V2X



B.Sc. Graduation Project
(Electronics & communications)

CONTENT

01 Introduction

02 ADAS System

03 V2V Communication

04 Traffic Lights and ambulance car

05 V2X Communication

06 Future work

INTRODUCTION

Advanced driver assistance system

ADAS

vehicle to vehicle communication

V2V

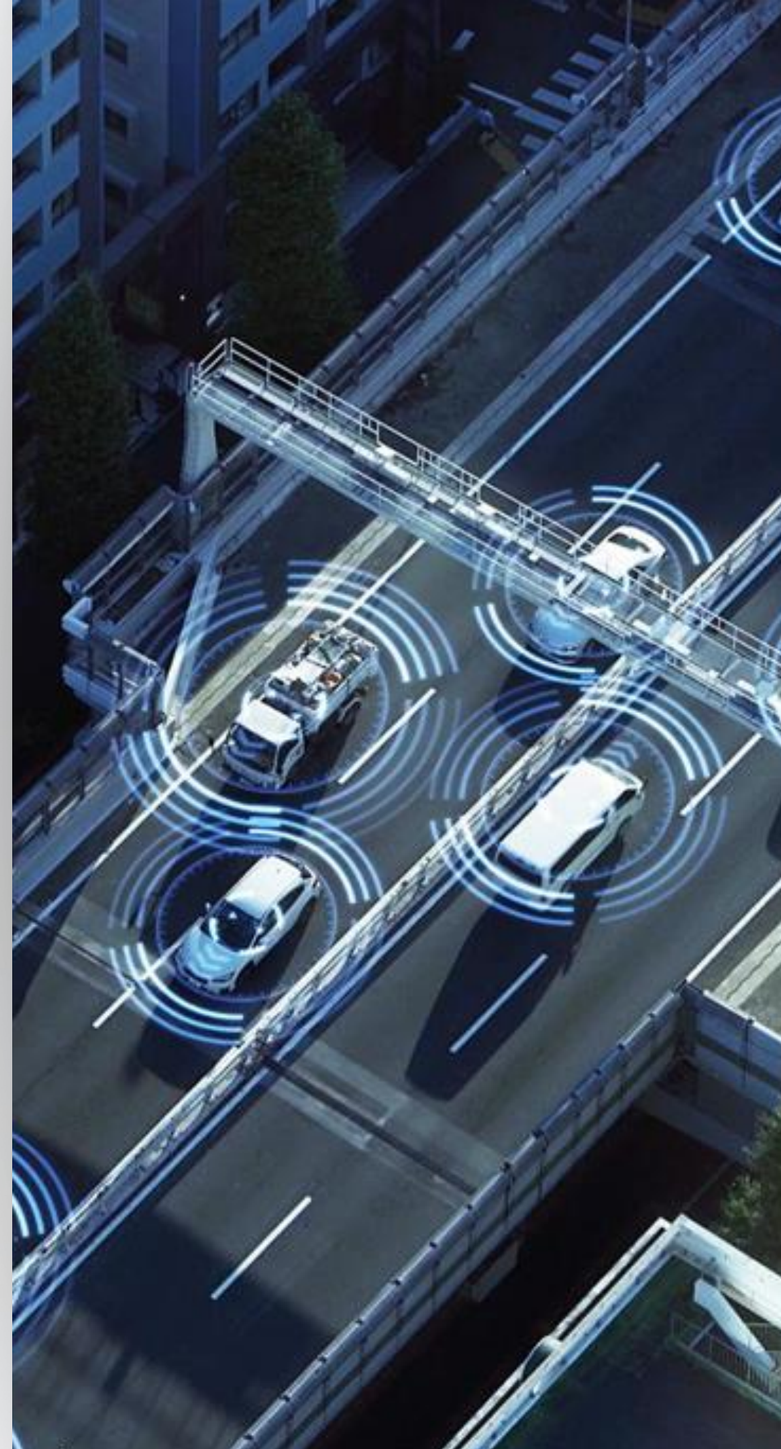
vehicle to traffic lights communication

V2X

WHY ADAS

Statistics indicate that human errors are one of the most significant causes of traffic accidents.

For example, according to a report issued by the National Highway Traffic Safety Administration in the United States, human error is responsible for about 94% of all traffic accidents.



GOALS AND OBJECTIVES

01
Prevent deaths and injuries by reducing the number of car accidents and the serious impact of those that cannot be avoided.

02
Reduce traffic fatalities and injuries by providing advanced warning systems, automated braking, lane departure warnings, blind-spot monitoring, and more.

03
Make the ambulance arrive as quickly as possible using V2X system.

OUR PROJECT

ADAS and V2V/V2X are technologies for safer and more efficient driving. ADAS uses sensors and cameras for features like lane and speed control, while V2V/V2X is direct communication between vehicles and infrastructure/devices.

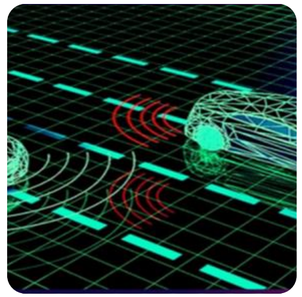
First system

ADAS

The project deals with the surrounding environment of the car according to the ADAS system using ultrasonic sensors and cameras.

Second system

V2V



The project also involves working on a vehicle-to-vehicle (V2V) system

Third system

V2I

The project also involves working on a vehicle-to-traffic lights (V2X) system

SYSTEM DISCRIPTION

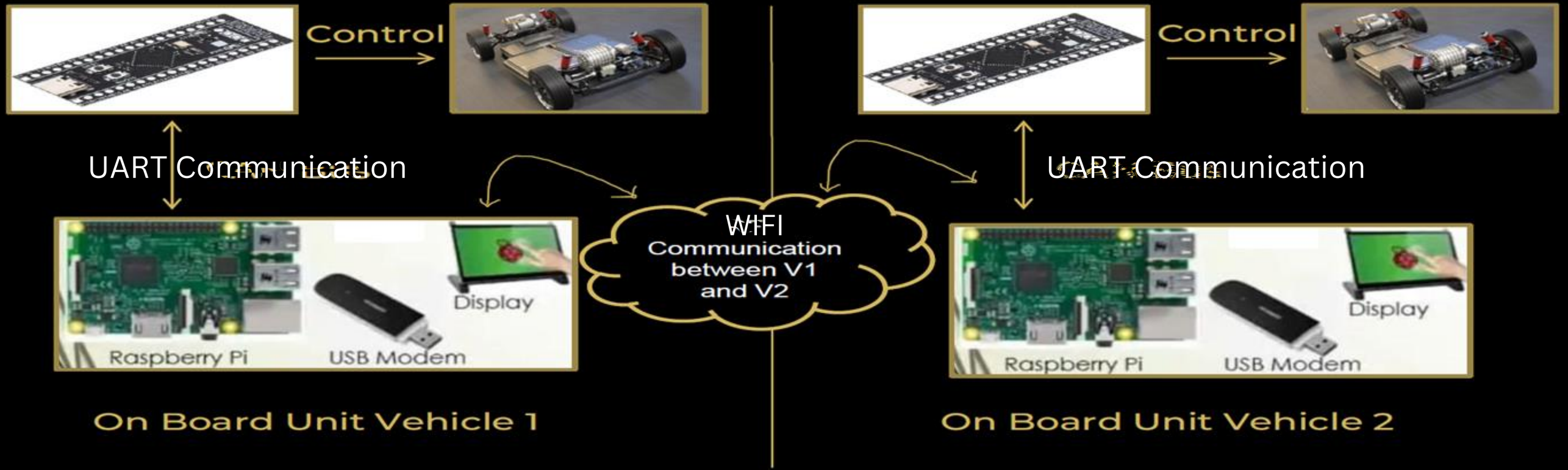
first part at project is V2V communication

- At this part first vehicle communicate with another vehicle to share speed , position , direction using WIFI communication

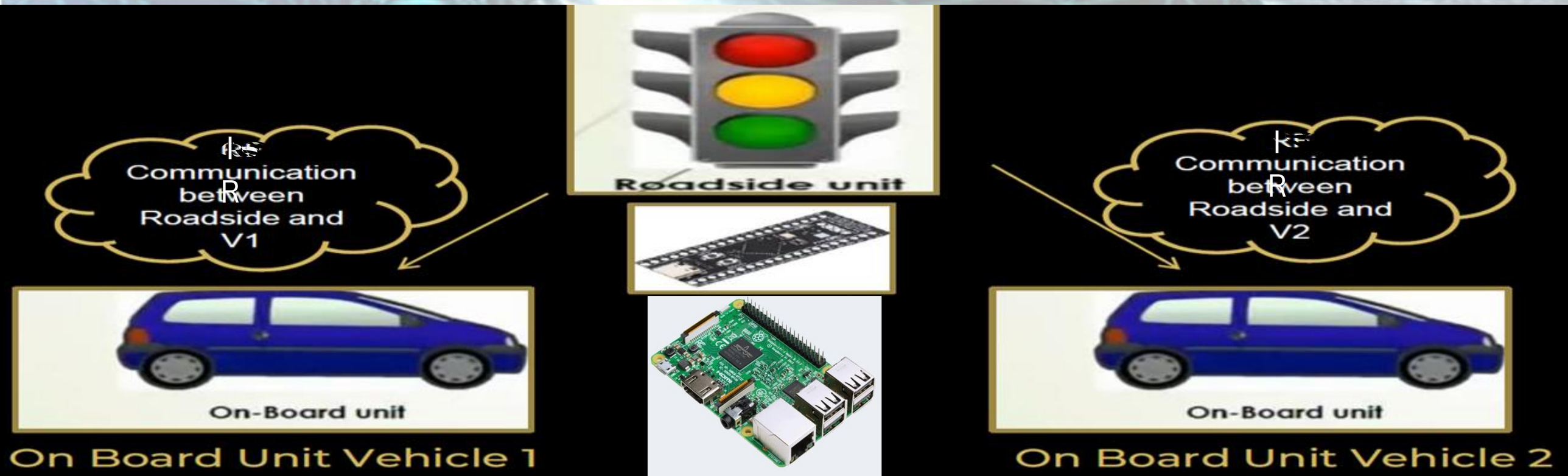
Second part at project is V2X communication

- At this part we communicate between vehicle and traffic lights to know statues of road to detect accident
- At project we using STM32 as master mc and it is communicate with Raspberry using UART communication

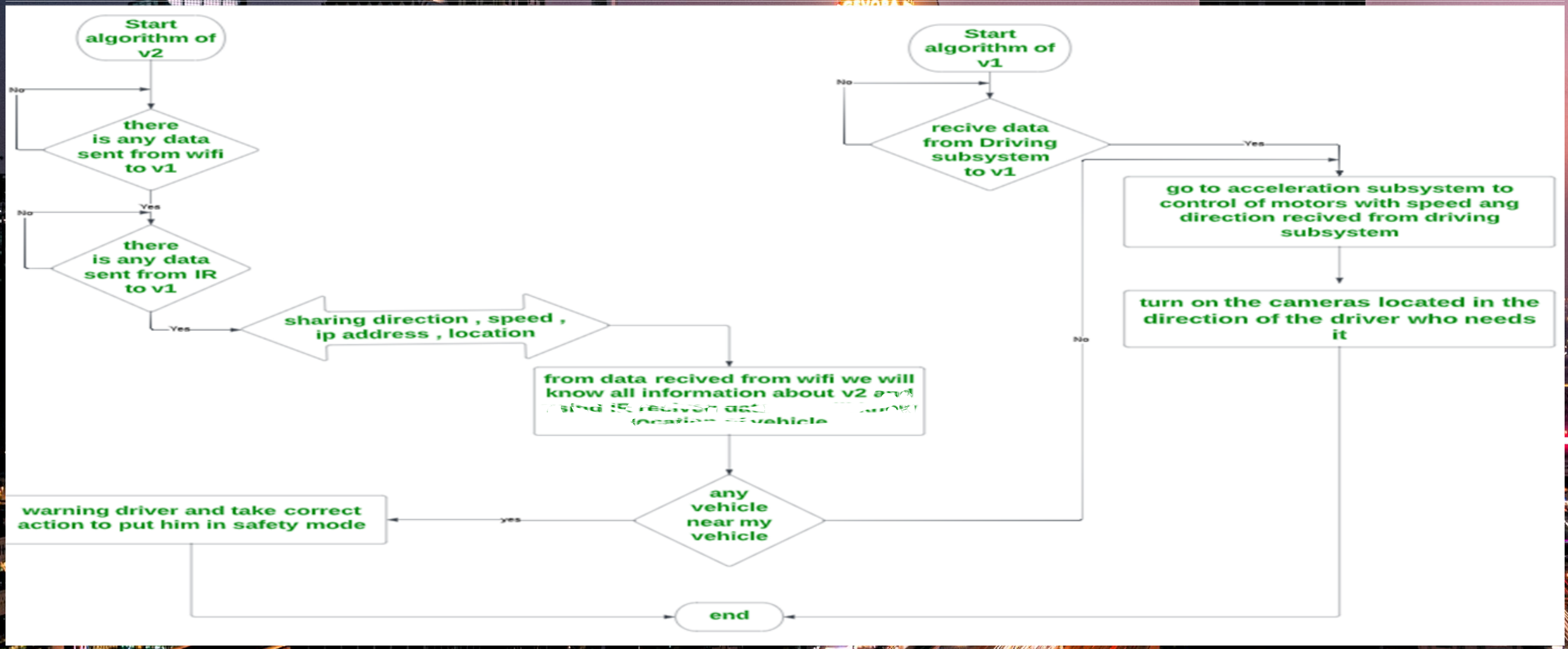
V2V BLOCK DIAGRAM



V2X BLOCK DIAGRAM



SYSTEM FLOW CHART


Start algorithm of v2
No
there is any data sent from wifi to v1
Yes
No
there is any data sent from IR to v1
Yes
sharing direction , speed , ip address , location
from data recived from wifi we will know all information about v2 and
any vehicle near my vehicle
yes
warning driver and take correct action to put him in safety mode
end
Start algorithm of v1
No
recive data from Driving subsystem to v1
Yes
go to acceleration subsystem to control of motors with speed ang direction recived from driving subsystem
turn on the cameras located in the direction of the driver who needs it
No

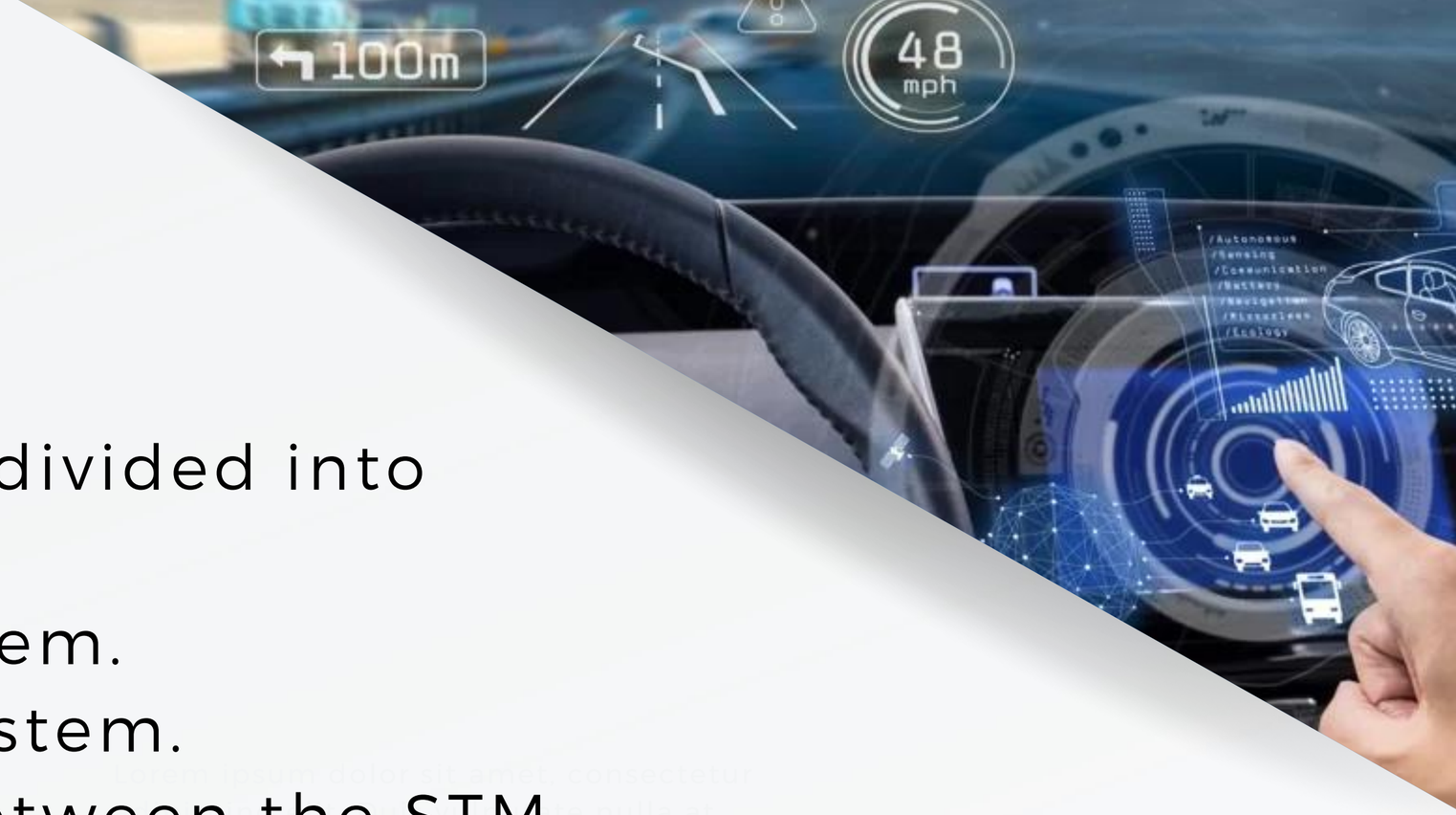
ADAS SYSTEM

Automotive in Vehicle-to-Vehicle

Linux with Raspberry pi Role in Vehicle-to-Vehicle

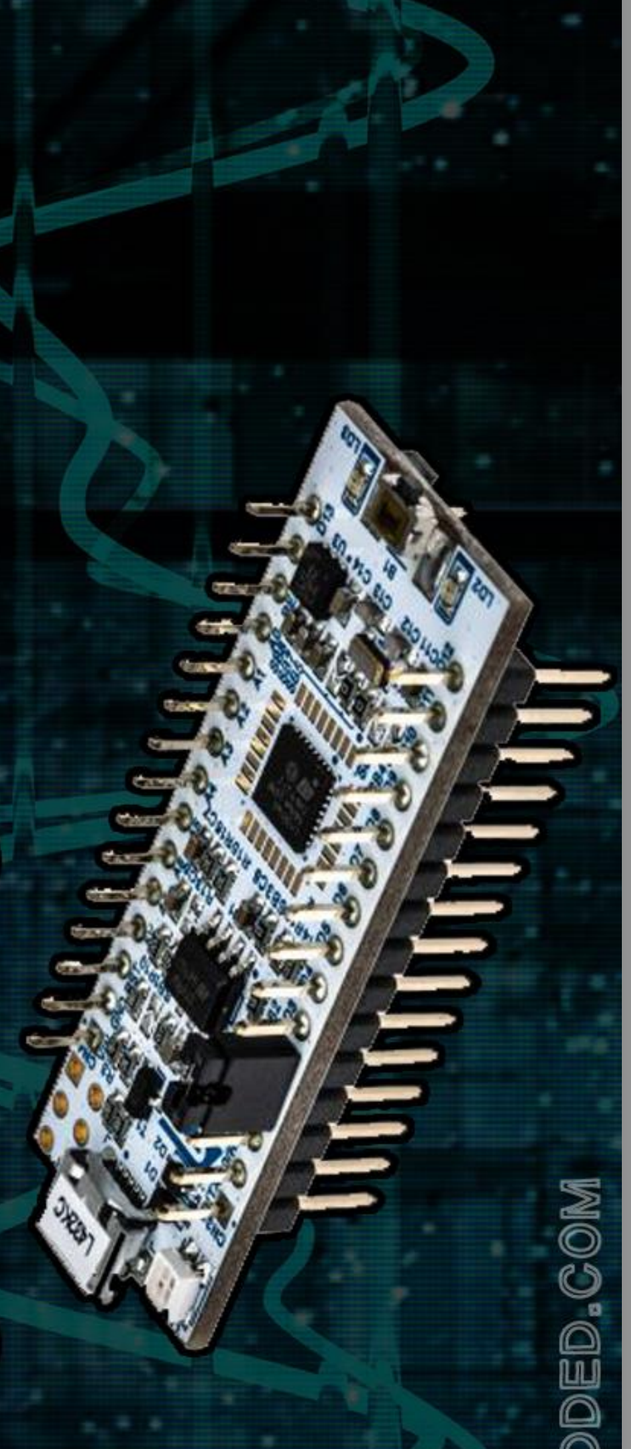
Automotive IN
Vehicle-to-Vehicle

ADAS IN Vehicle-to-Vehicle



The Device application is divided into four main Tasks:

- The Processing subsystem.
- The acceleration subsystem.
- The Communication between the STM processing and STM acceleration.
- Our cases handling of project.

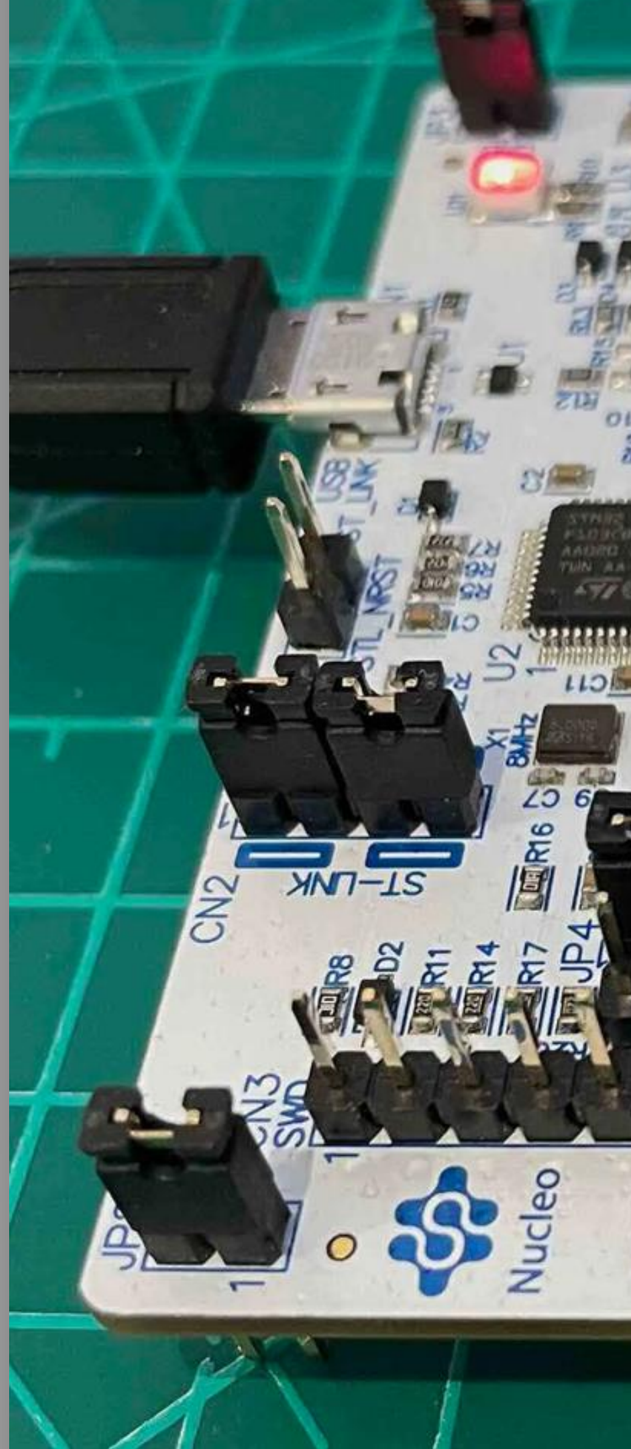


PROCESSING SUBSYSTEM TASKS

- Receiving my control data from bluetooth module.
- Receiving Speed of car (B) from Raspberry pi using UART Communication.
- Calculate the distance between me and around objects.
- Process these data and sending it to acceleration STM.

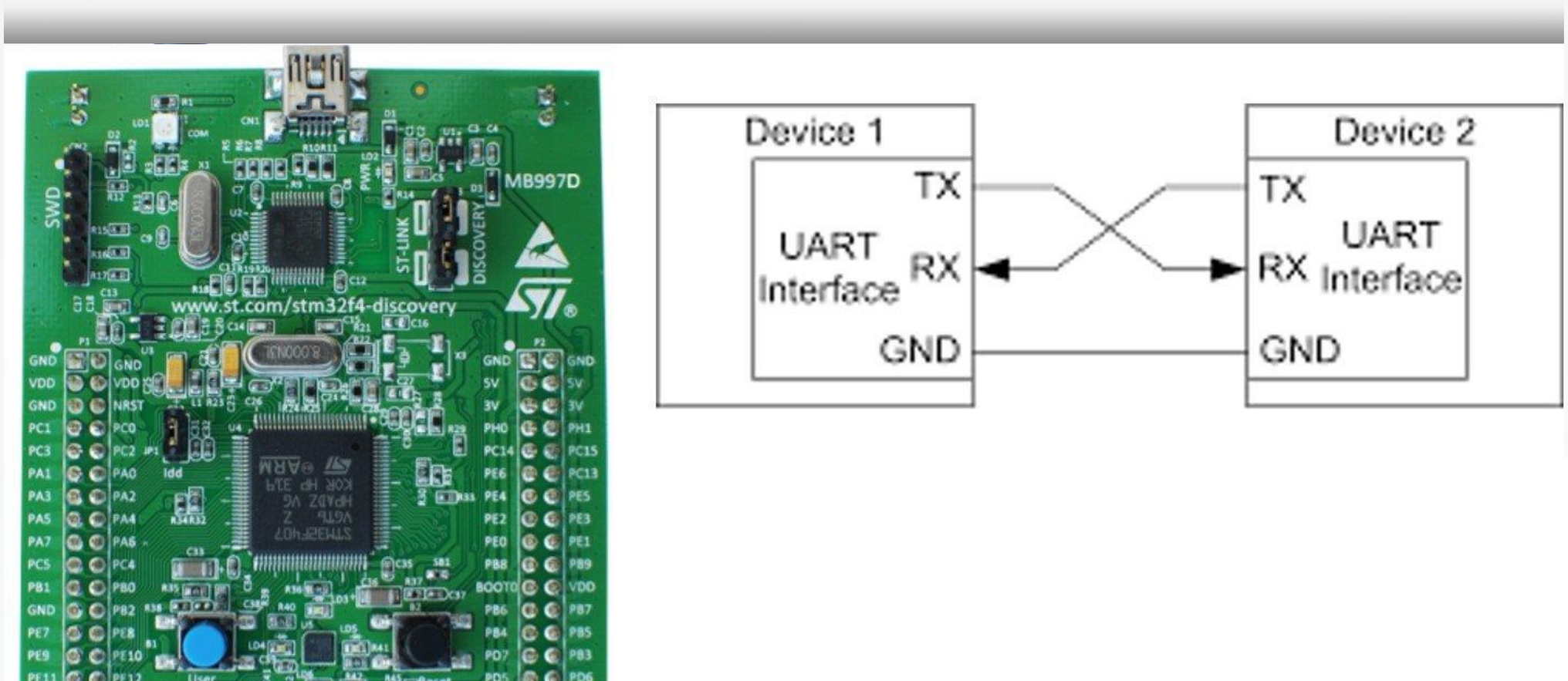
ACCELERATION SUBSYSTEM TASKS

- Receiving my speed and direction from STM Processing using UART.
- Sending PWM signal using timer peripheral to control of motors.
- Displaying data of speed, direction and alarms notifications to TFT.



The Communication between two STMs.

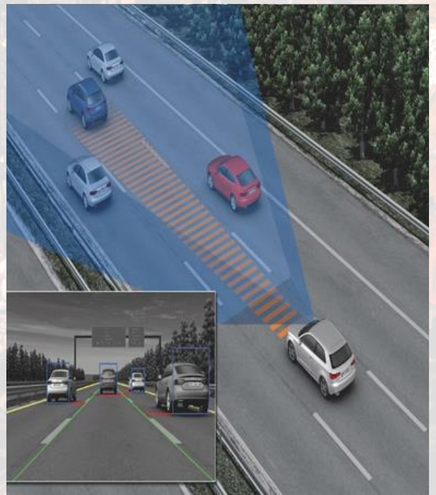
- STM Processing (TX) will send directions, alarms and speed to STM acceleration (RX) by using the communication protocol UART.



OUR CASES HANDLING OF PROJECT

Forward moving and Overtake safety

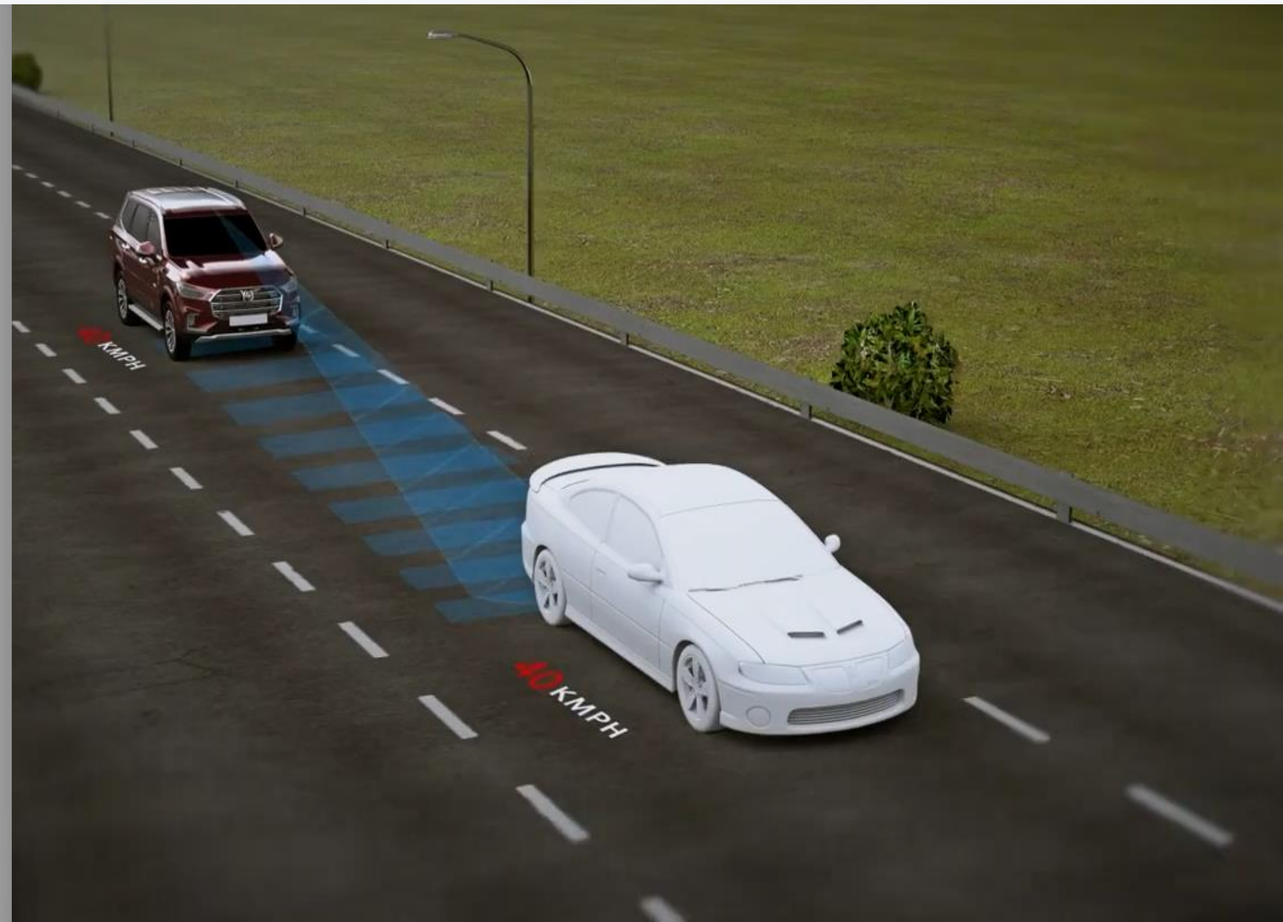
Left and write moving



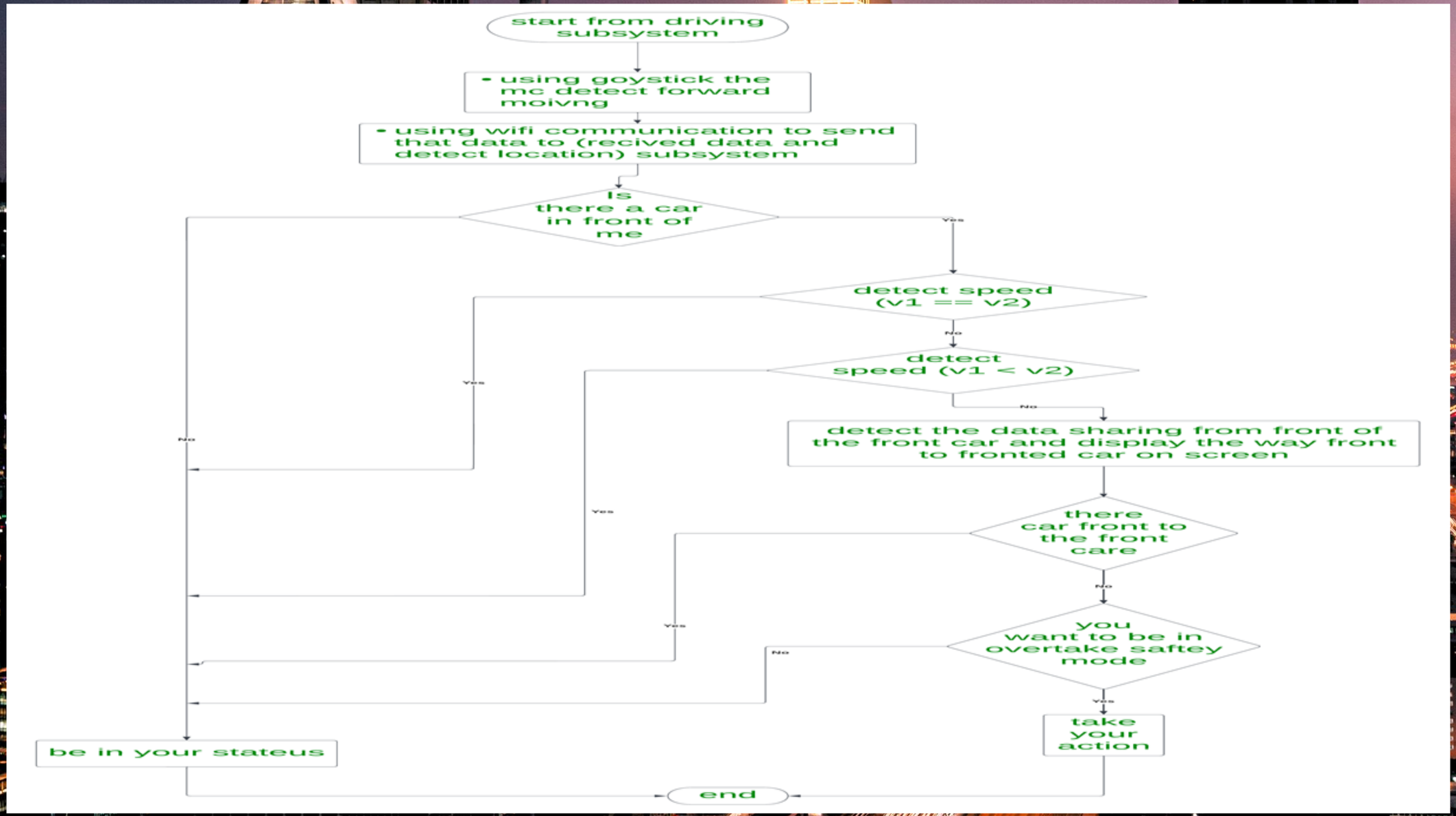
Backward moving (parking)

FORWARD MOVING AND OVERTAKE SAFETY

- If the driver wants to move forward and there is a car front of me , detect the speed
- If my speed less than or equal to v2 , become in my statues
- If my speed bigger than v2 , detect data sharing from v2
- If there is a care front to the fronted car, and you want to be in overtake safety mode , be in your statues
- Else be in your statues or take action to be in overtake safety mode



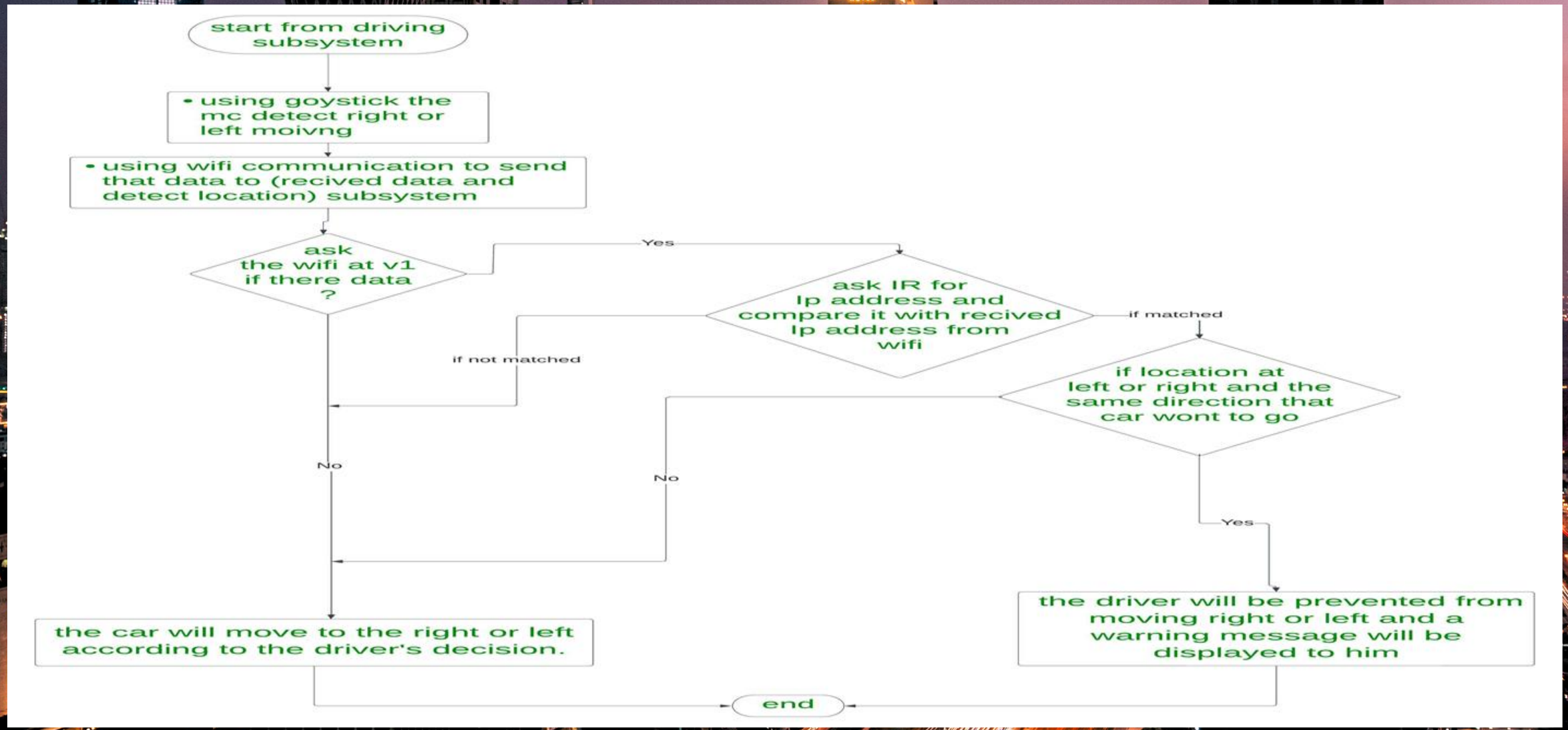
SUBSYSTEM FLOW CHART


start from driving subsystem
- using goystick the mc detect forward moivng
- using wifi communication to send that data to (recived data and detect location) subsystem
Is there a car in front of me
Yes
No
detect speed (v1 == v2)
Yes
No
detect speed (v1 < v2)
Yes
No
detect the data sharing from front of the front car and display the way front to fronted car on screen
there car front to the front care
Yes
No
you want to be in overtake saftey mode
Yes
No
take your action
be in your stateus
end

LEFT AND WRITE MOVING

- If the driver wants to move right or left and there is a car in the write or left , the driver will be prevented from moving right or left and a warning message will be displayed to him
- If the driver wants to move right or left and there is not a car in the blind spot, the car will move to the right or left according to the driver's decision.

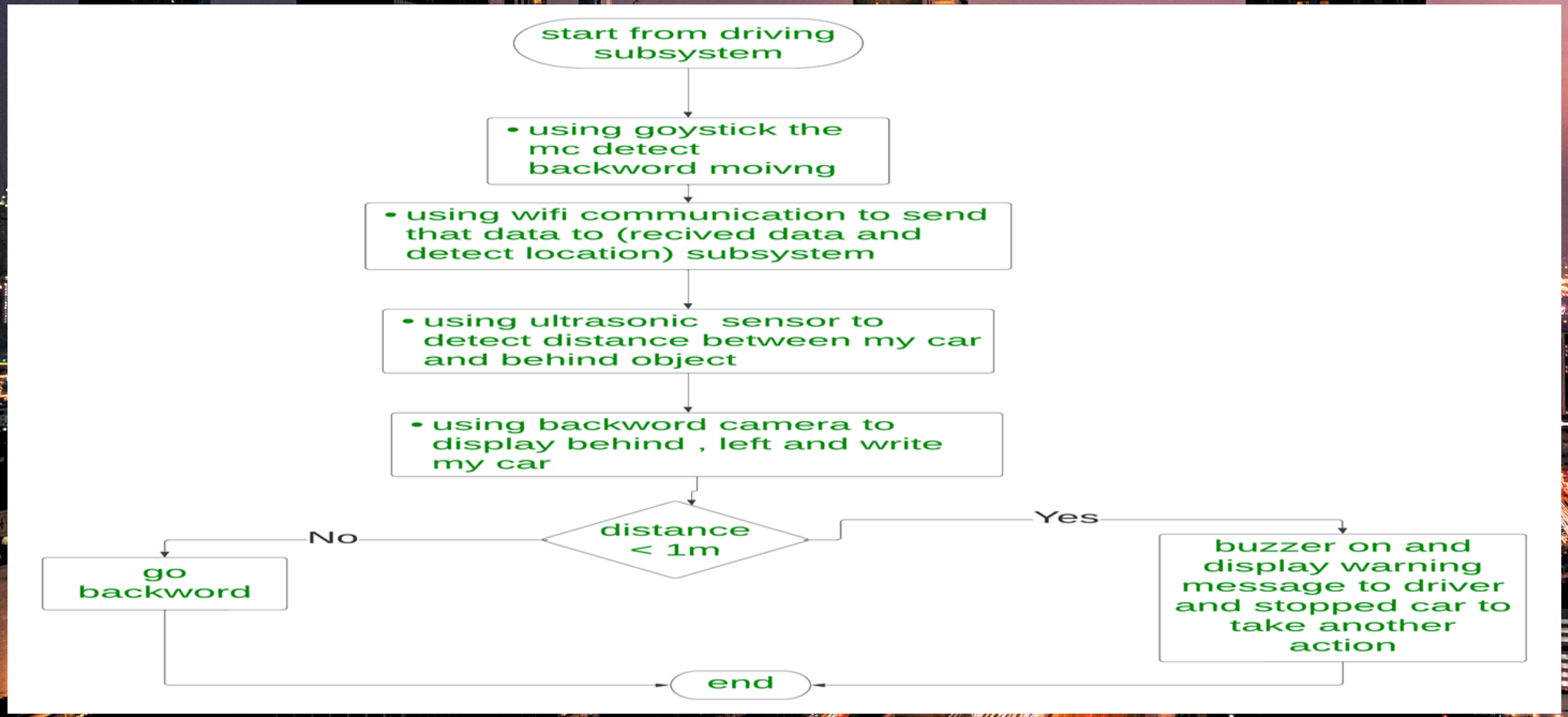
SUBSYSTEM FLOW CHART

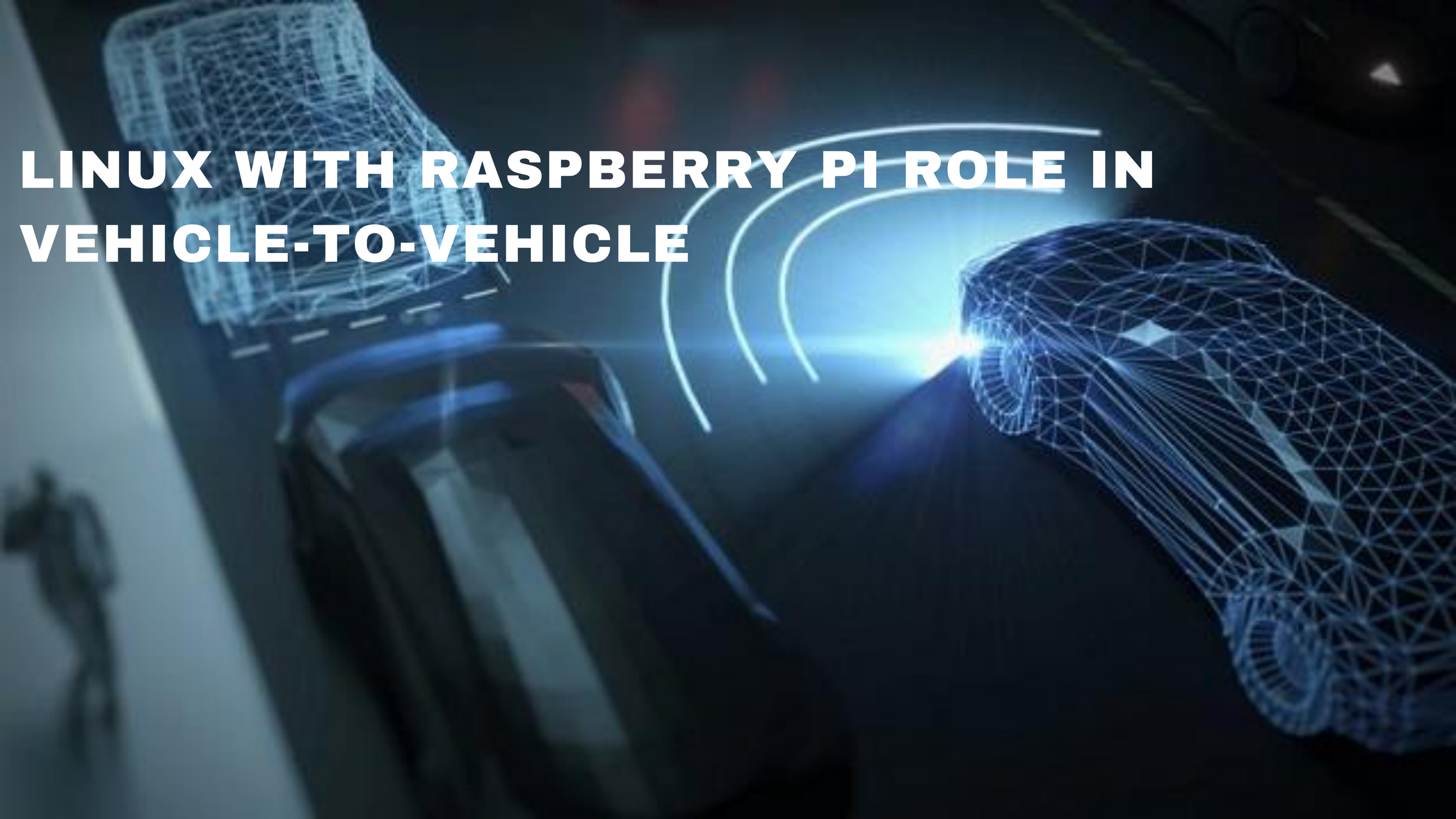

start from driving subsystem
• using goystick the mc detect right or left moivng
• using wifi communication to send that data to (recived data and detect location) subsystem
ask the wifi at v1 if there data ?
Yes
ask IR for Ip address and compare it with recived Ip address from wifi
if matched
if not matched
if location at left or right and the same direction that car wont to go
No
No
Yes
the car will move to the right or left according to the driver's decision.
the driver will be prevented from moving right or left and a warning message will be displayed to him
end

BACKWARD MOVING (PARKING)

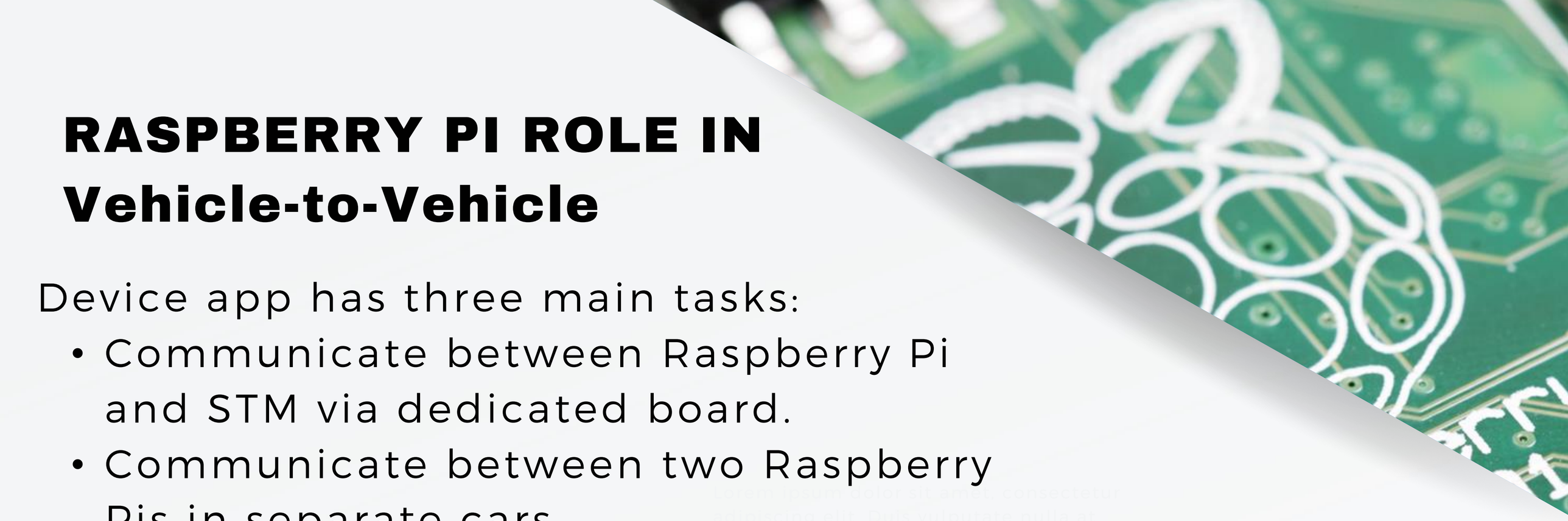
- If the driver wants to move back and distance between him and behind objectless than 1m , the driver will be prevented from moving backward and a warning message will be displayed to him
- Else the car moved behind safety

SUBSYSTEM FLOW CHART


start from driving subsystem
• using goystick the mc detect backword moivng
• using wifi communication to send that data to (recived data and detect location) subsystem
• using ultrasonic sensor to detect distance between my car and behind object
• using backword camera to display behind , left and write my car
distance < 1m
No
Yes
go backword
buzzer on and display warning message to driver and stopped car to take another action
end



LINUX WITH RASPBERRY PI ROLE IN VEHICLE-TO-VEHICLE



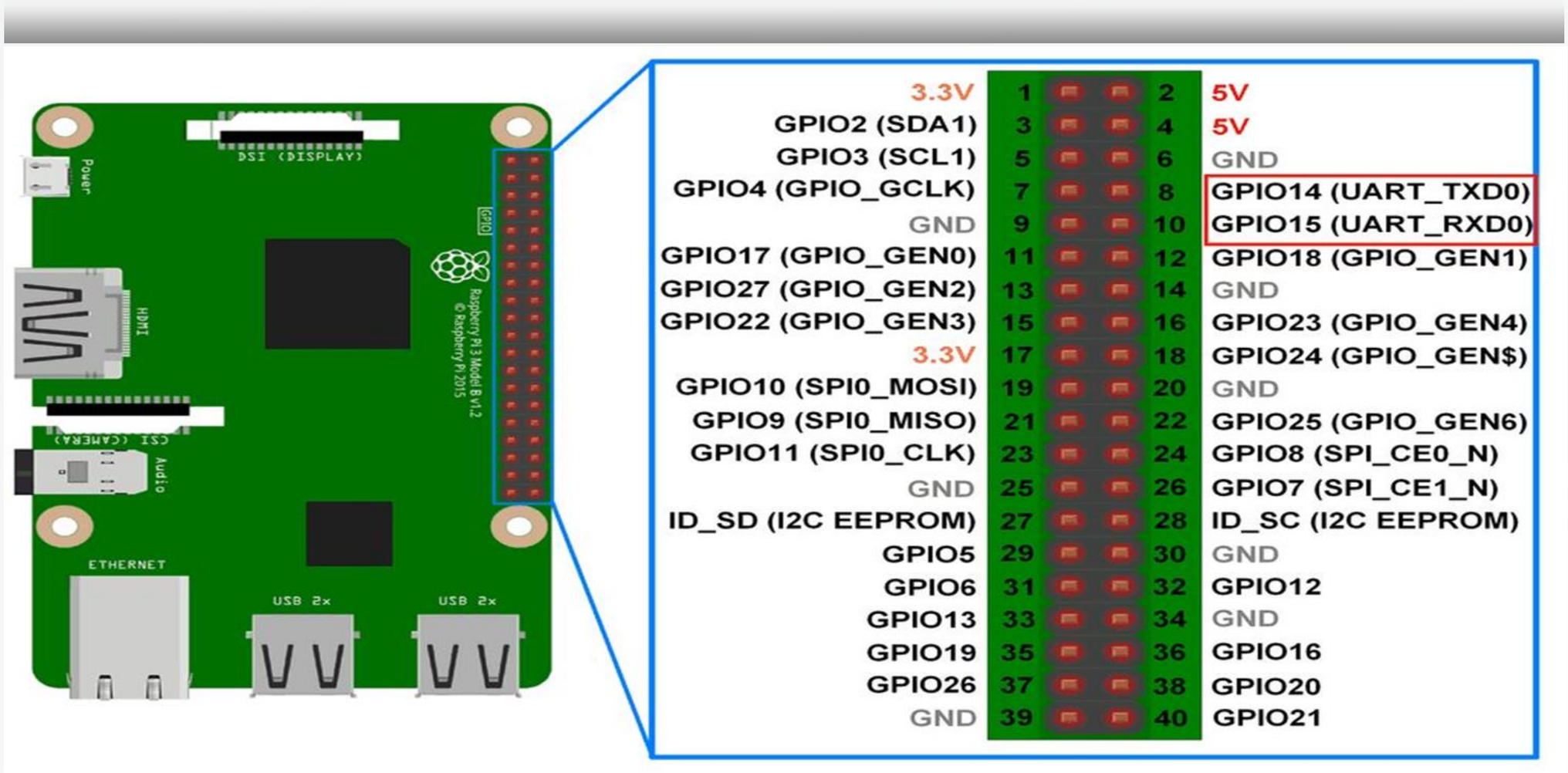
RASPBERRY PI ROLE IN Vehicle-to-Vehicle

Device app has three main tasks:

- Communicate between Raspberry Pi and STM via dedicated board.
- Communicate between two Raspberry Pis in separate cars.
- Control direction, detect color, and send data to STM.

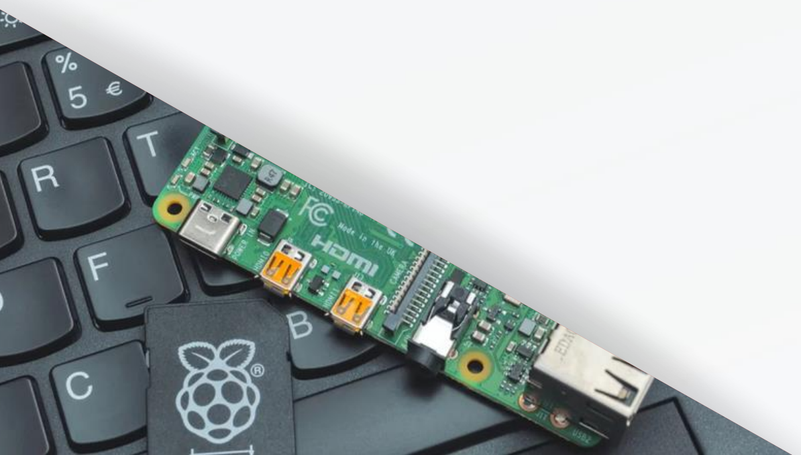
The Communication between the raspberry pi board and the STM.

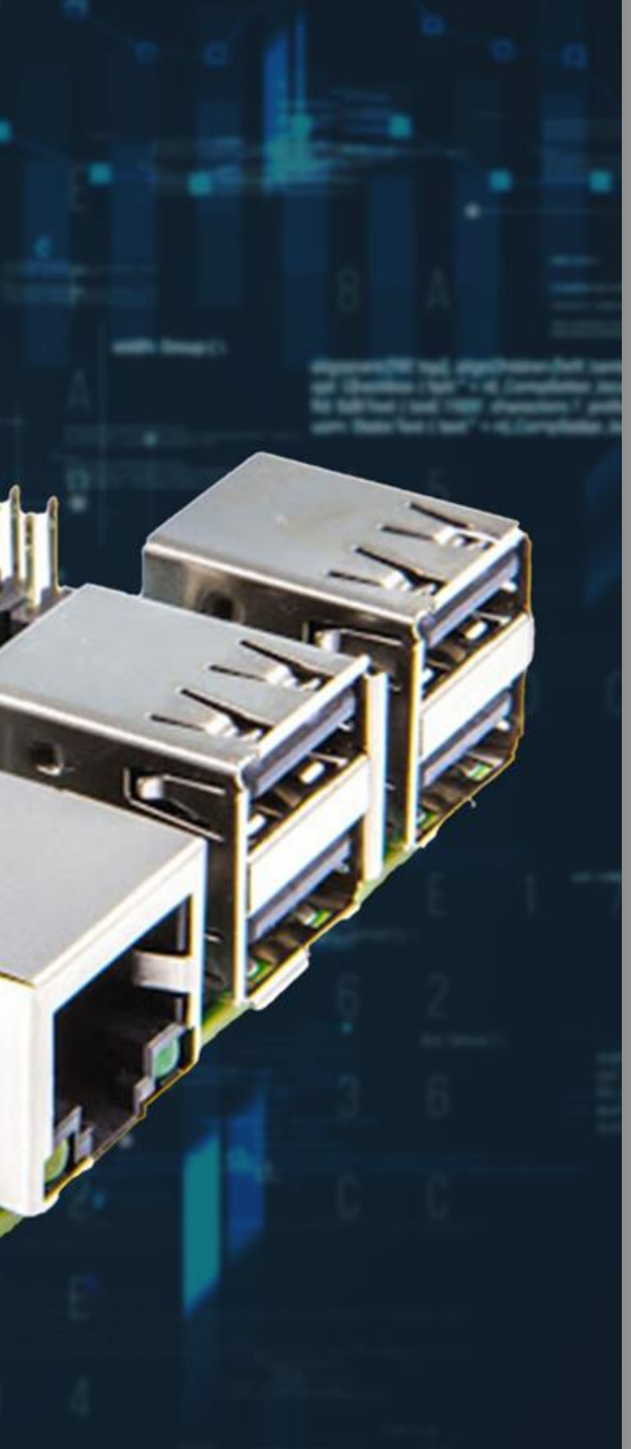
- STM (TX)will send directions to raspberry pi (RX) by using the communication protocol UART.


DSI (DISPLAY)
Power
HDMI
CSI (CAMERA)
Audio
ETHERNET
USB 2x
USB 2x
GPIO
Raspberry Pi 3 Model B v1.2
© Raspberry Pi 2015
3.3V 1 2 5V
GPIO2 (SDA1) 3 4 5V
GPIO3 (SCL1) 5 6 GND
GPIO4 (GPIO_GCLK) 7 8 GPIO14 (UART_TXD0)
GND 9 10 GPIO15 (UART_RXD0)
GPIO17 (GPIO_GEN0) 11 12 GPIO18 (GPIO_GEN1)
GPIO27 (GPIO_GEN2) 13 14 GND
GPIO22 (GPIO_GEN3) 15 16 GPIO23 (GPIO_GEN4)
3.3V 17 18 GPIO24 (GPIO_GEN$)
GPIO10 (SPI0_MOSI) 19 20 GND
GPIO9 (SPI0_MISO) 21 22 GPIO25 (GPIO_GEN6)
GPIO11 (SPI0_CLK) 23 24 GPIO8 (SPI_CE0_N)
GND 25 26 GPIO7 (SPI_CE1_N)
ID_SD (I2C EEPROM) 27 28 ID_SC (I2C EEPROM)
GPIO5 29 30 GND
GPIO6 31 32 GPIO12
GPIO13 33 34 GND
GPIO19 35 36 GPIO16
GPIO26 37 38 GPIO20
GND 39 40 GPIO21

WHAT IS THE DATA THAT STM WILL SEND TO RASPBERRYPI ?!

- STM will send directions to raspberry pi :
- Go
- Back
- Backward left
- Backward right
- Forward left
- Forward right





RASPBERRY PI IN THE OTHER CAR(B)

- in the other car the raspberry pi (B) will receive data from arduino :
- Raspberry pi(B) will receive speeds 1,2,3 from arduino by using communication protocol UART.
- Raspberry pi (B) will send speeds and the color of the car to the second raspberry pi (A) by using WiFi.

DIRECTIONS CONTROL , COLOR DETECTION and sending data to STM.

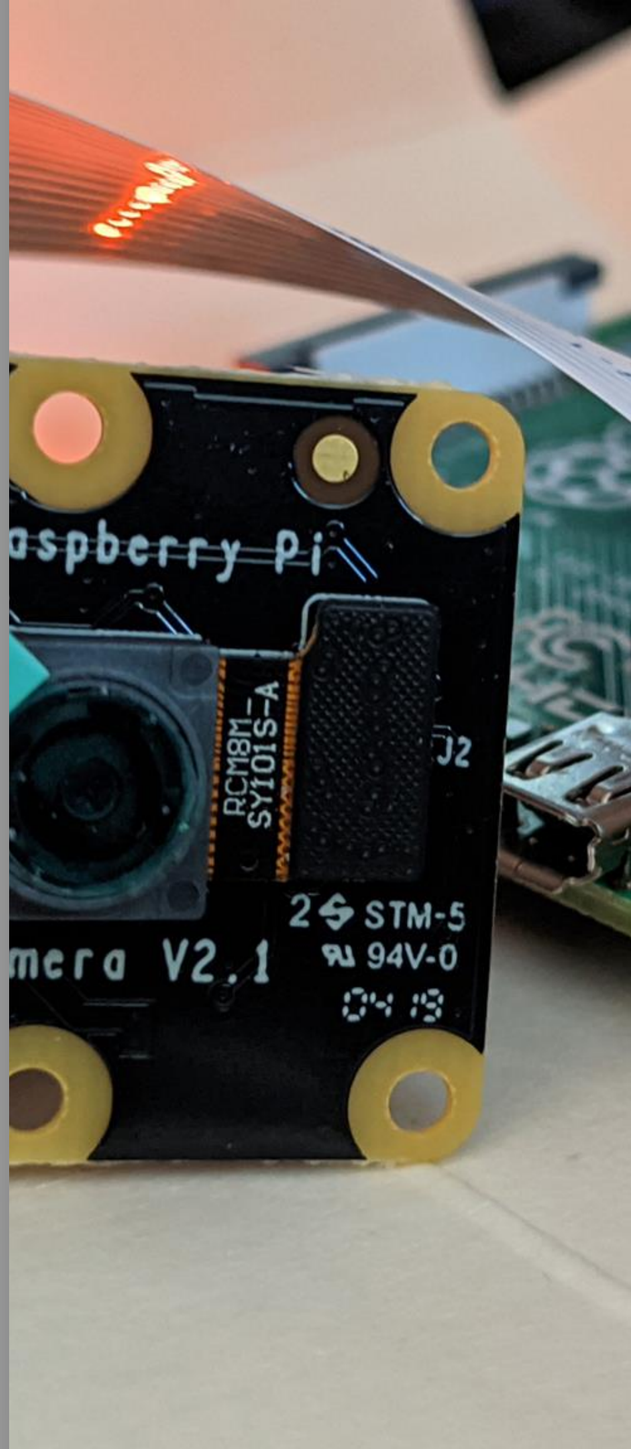
In my car I have directions , speeds , color and camera connected to stepper motor .

If data is GO :

- WIFI
- Color detection
- Compare color
- Send speed and color

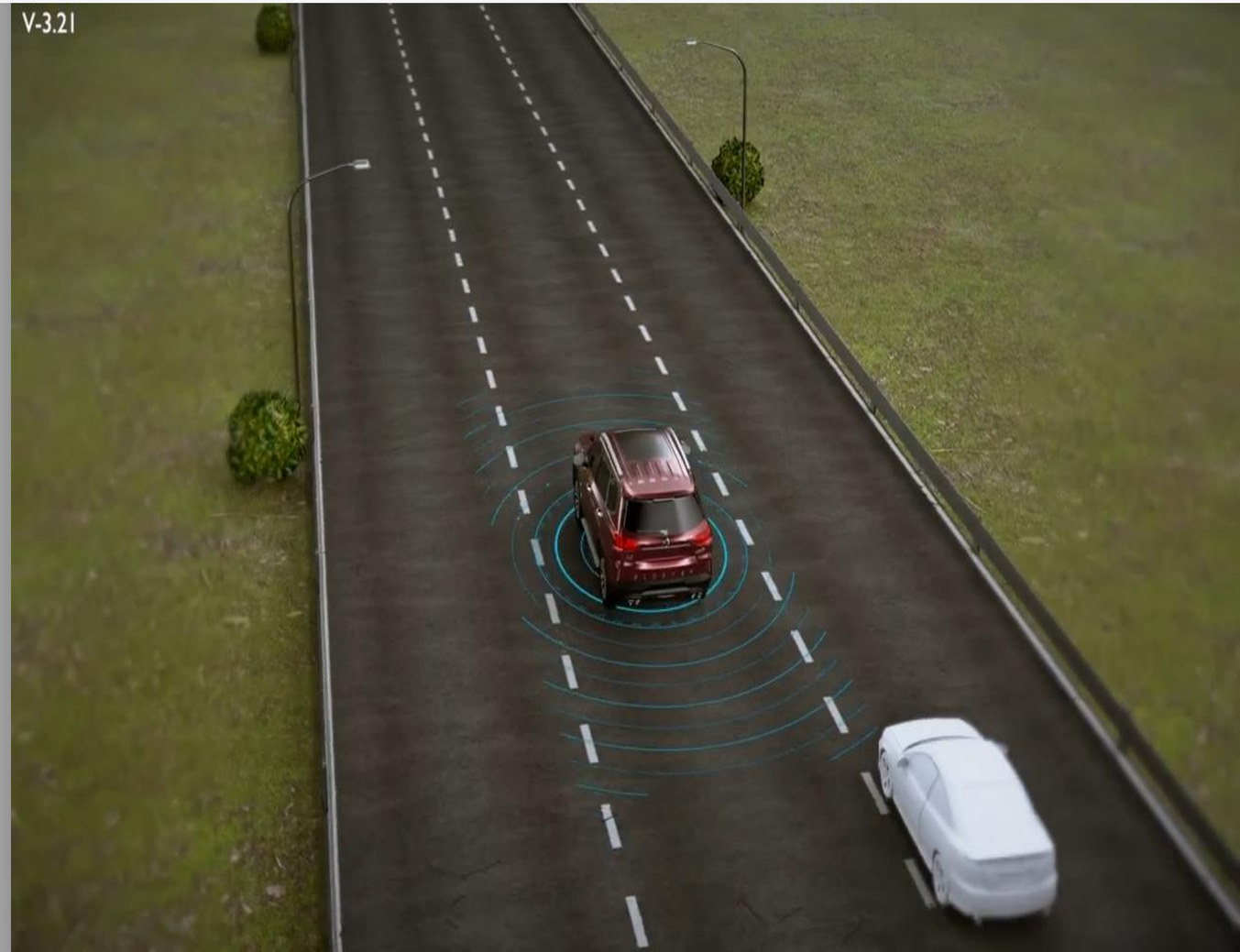
If the received data is back :

- The stepper motor connected to the camera on the Raspberry pi will rotate 180 degree and the camera will be open .

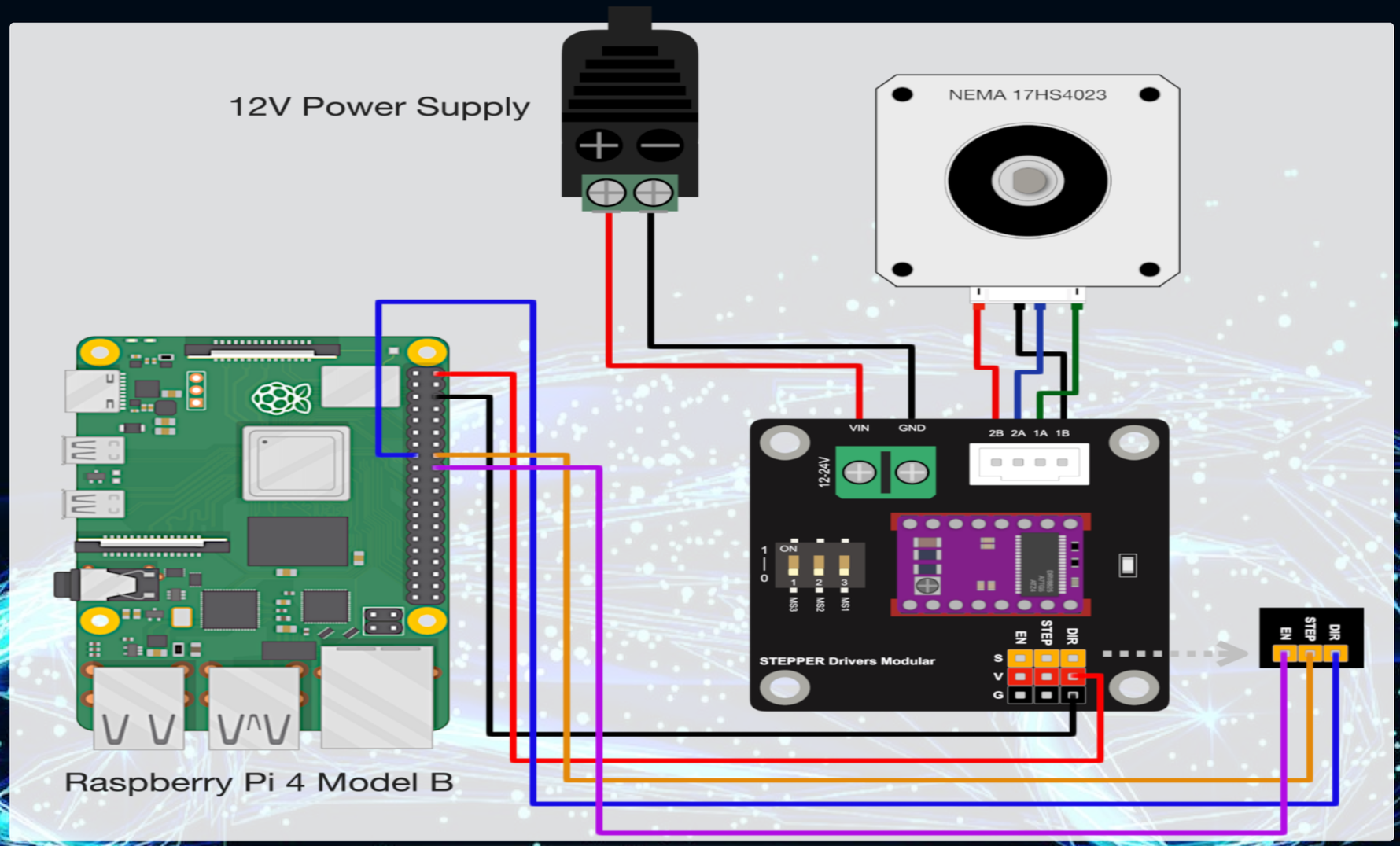


BLIND SPOT

- The driver cannot see if there is a car in the blind spot or not
- If the driver wants to move right or left and there is a car in the blind spot, the driver will be prevented from moving right or left and a warning message will be displayed to him
- If the driver wants to move right or left and there is not a car in the blind spot, the car will move to the right or left according to the driver's decision.



Camera with Stepper motor



THE CAMERA WILL OPEN IN FOUR DIRECTIONS:

The backward left direction :

The stepper motor connected to the camera on the Raspberry pi will rotate 90 degree anti-clockwise and the camera will be open .

The backward right direction :

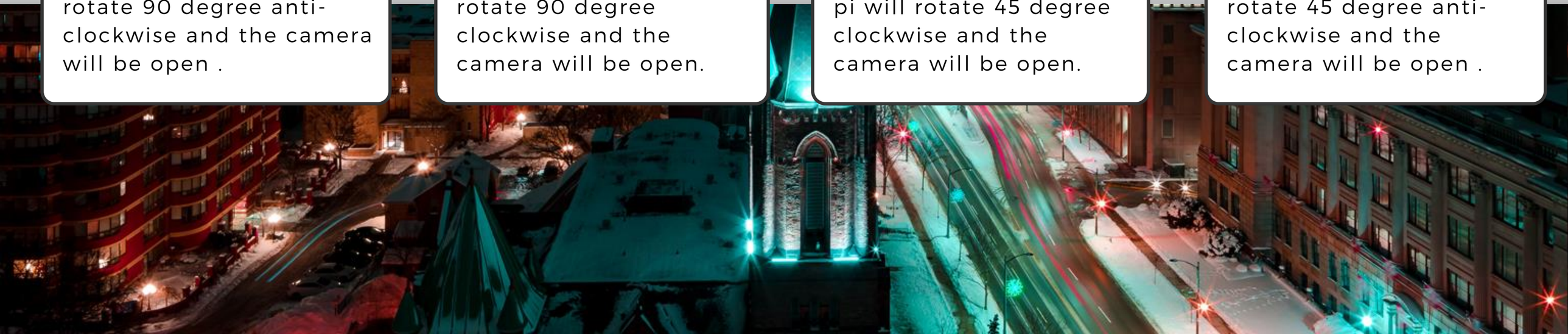
The stepper motor connected to the camera on the Raspberry pi will rotate 90 degree clockwise and the camera will be open.

The forward right direction :

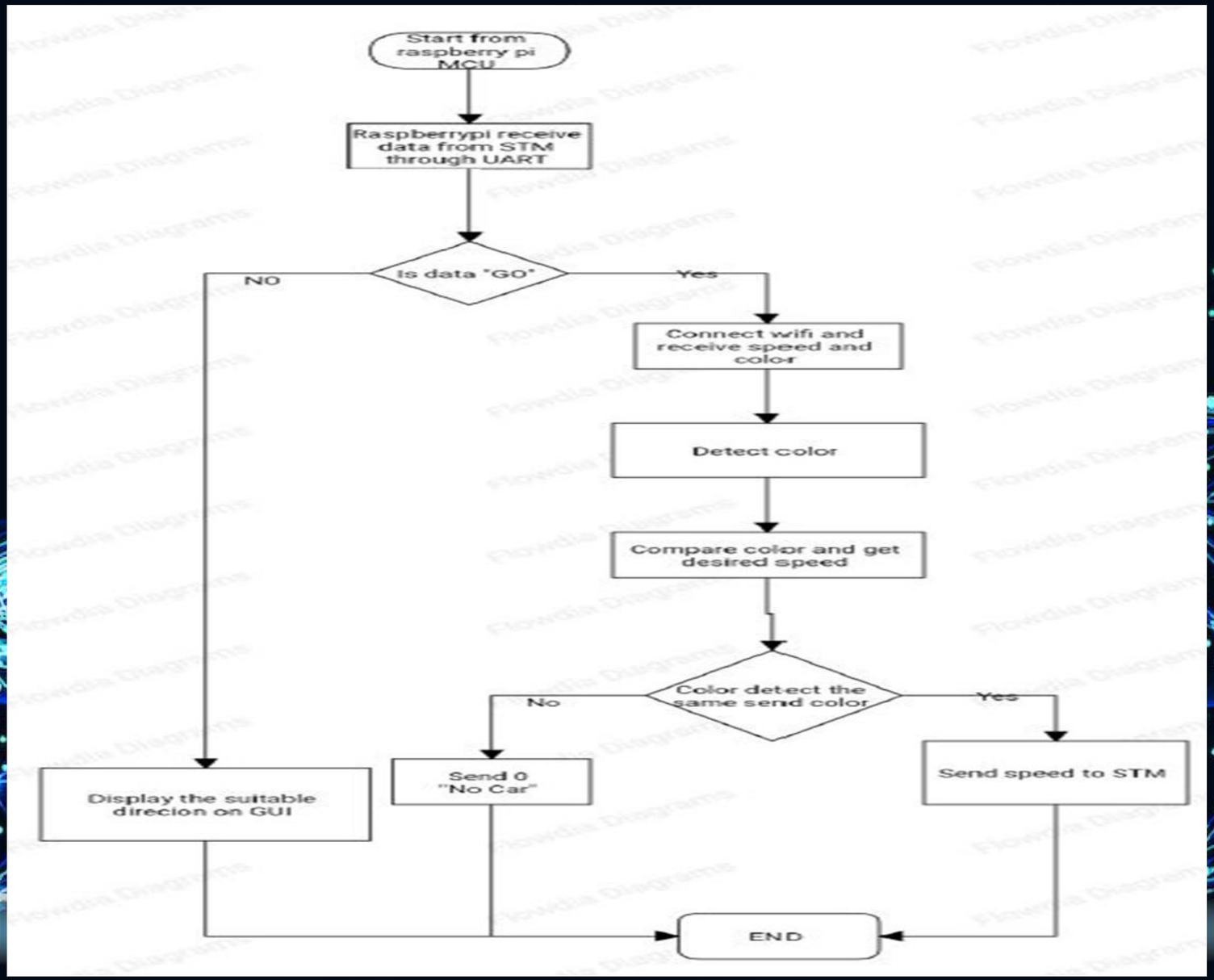
The stepper motor connected to the camera on the Raspberry pi will rotate 45 degree clockwise and the camera will be open.

The forward left direction :

The stepper motor connected to the camera on the Raspberry pi will rotate 45 degree anti-clockwise and the camera will be open .



SUBSYSTEM FLOW CHART

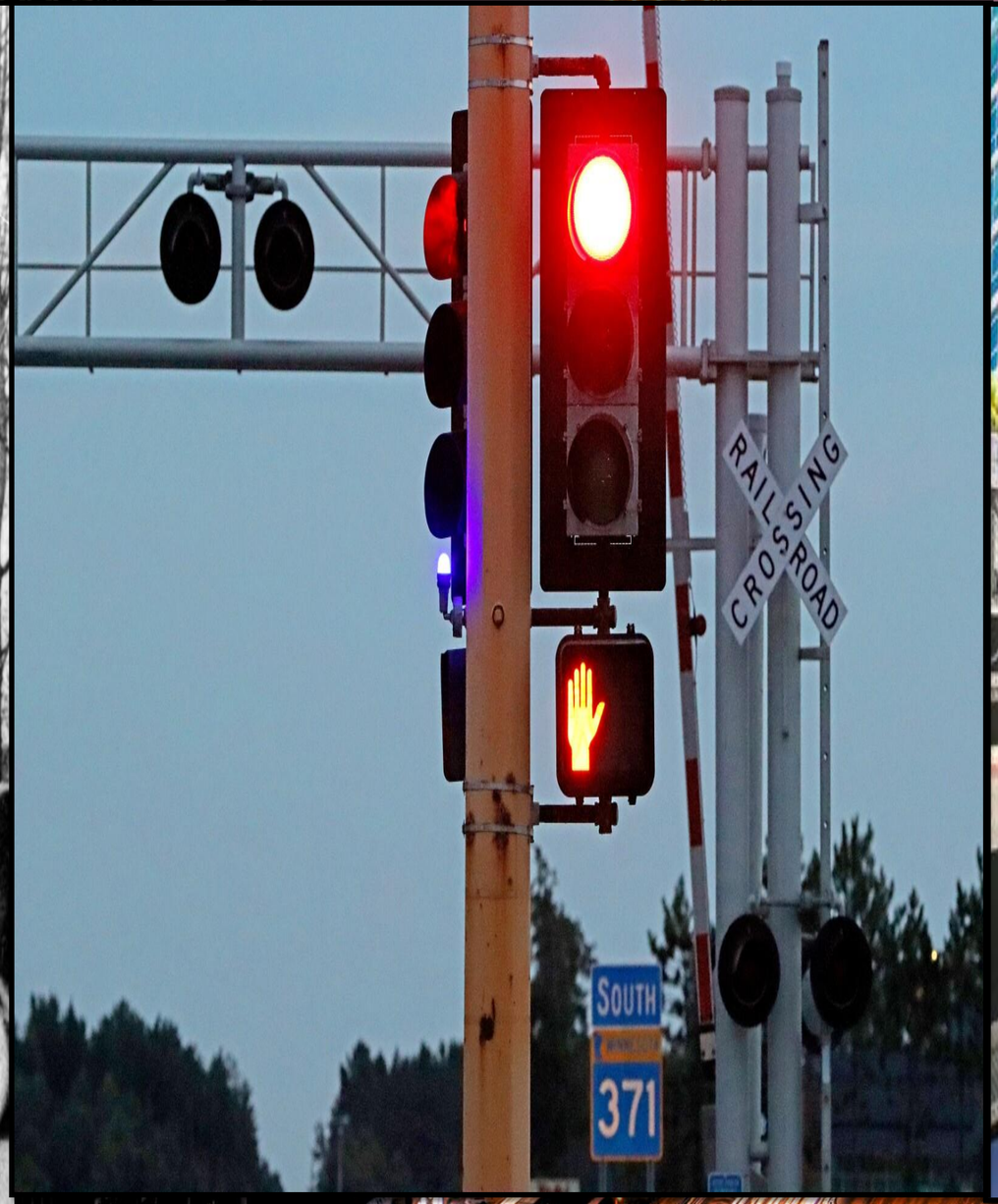


AMBULANCE V2X SYSTEM

Traffic light system

- A traffic light controls vehicular and pedestrian traffic at intersections and road crossings. It consists of three or four colored lights - red, yellow, and green - that indicate when to stop, slow down, or proceed safely.
- Traffic lights improve road safety and efficiency and are controlled by computer systems that adjust timing based on traffic flow.

History of traffic light

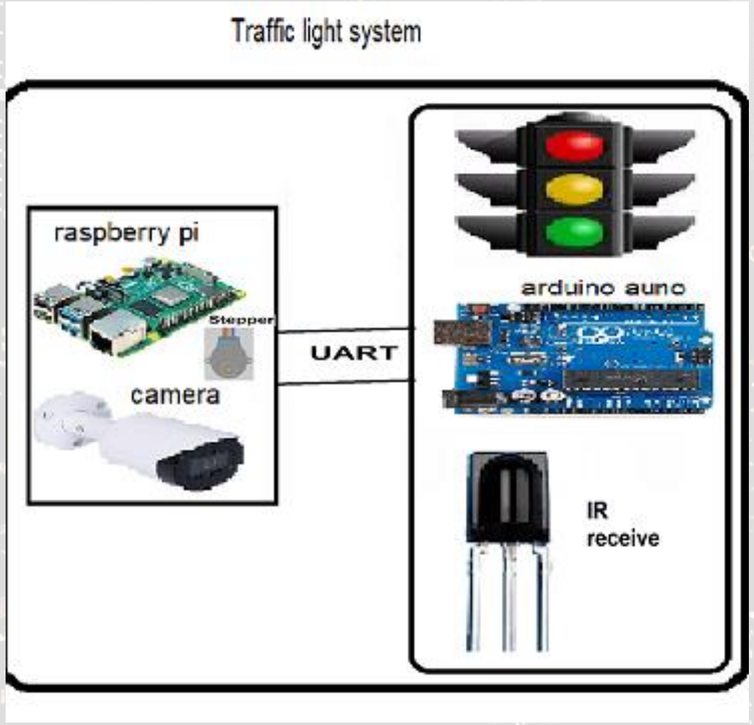


Traffic light with ambulance system

Ambulances and firefighters depend on traffic and roads. Therefore, we thought of linking the
traffic light to both the ambulance and the fire engine, in order to open the way for them when they pass.

Our Traffic light system

HW



SW

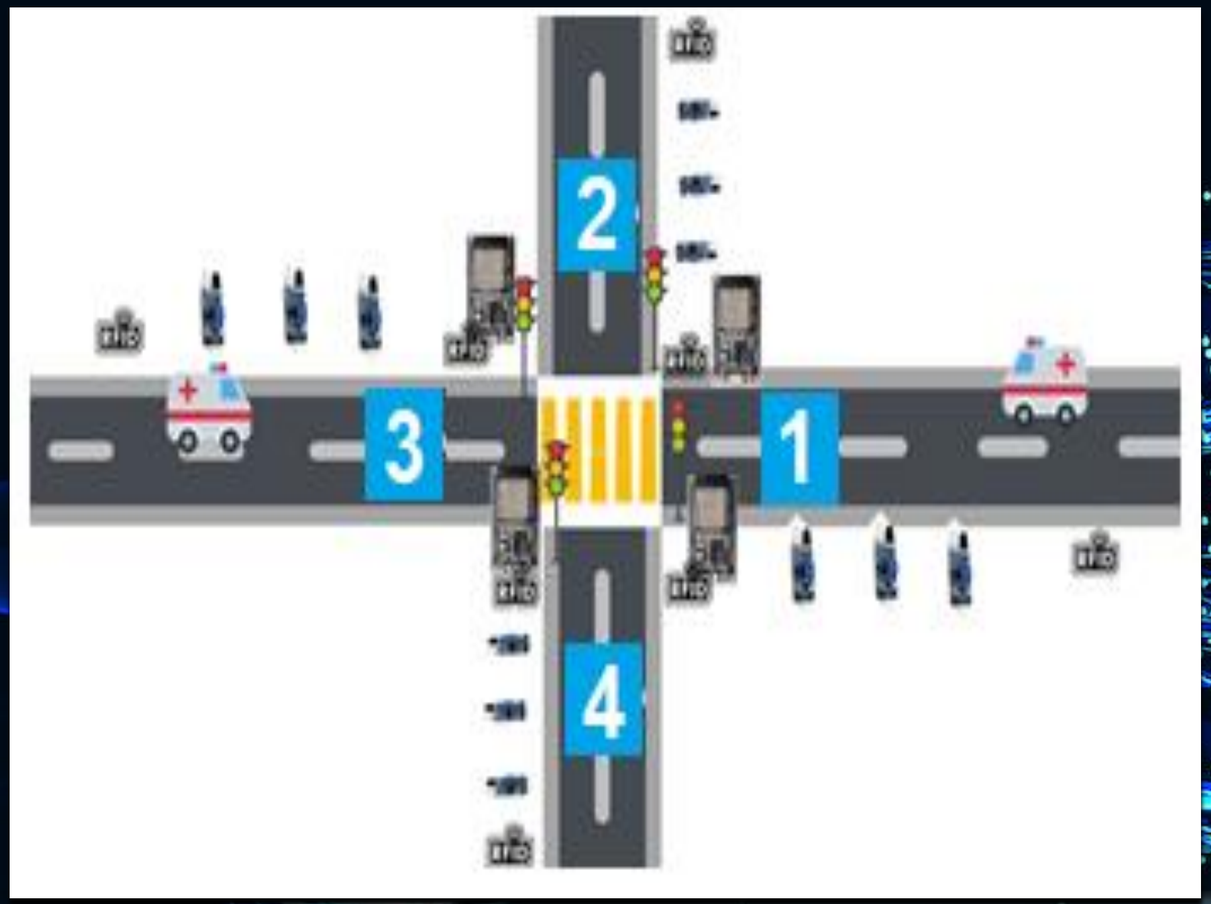
python
Programming

ARDUINO

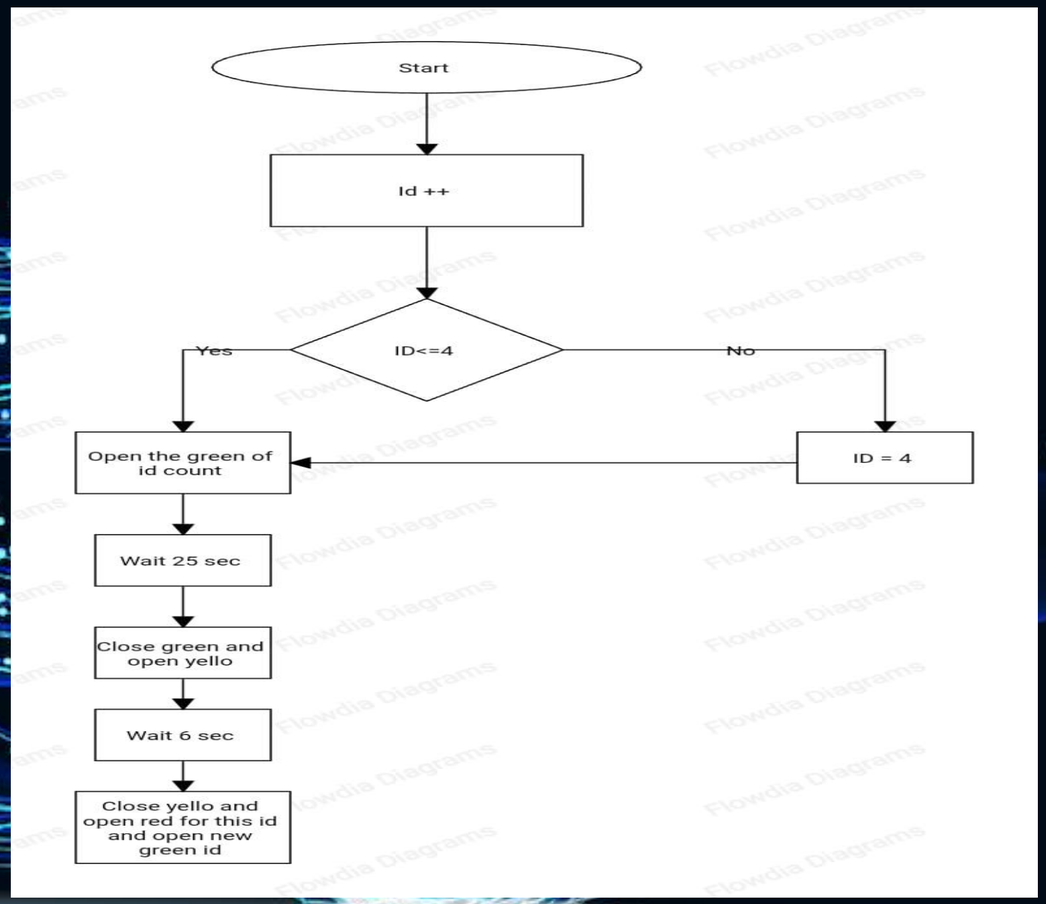
C++

Algorithm of traffic light

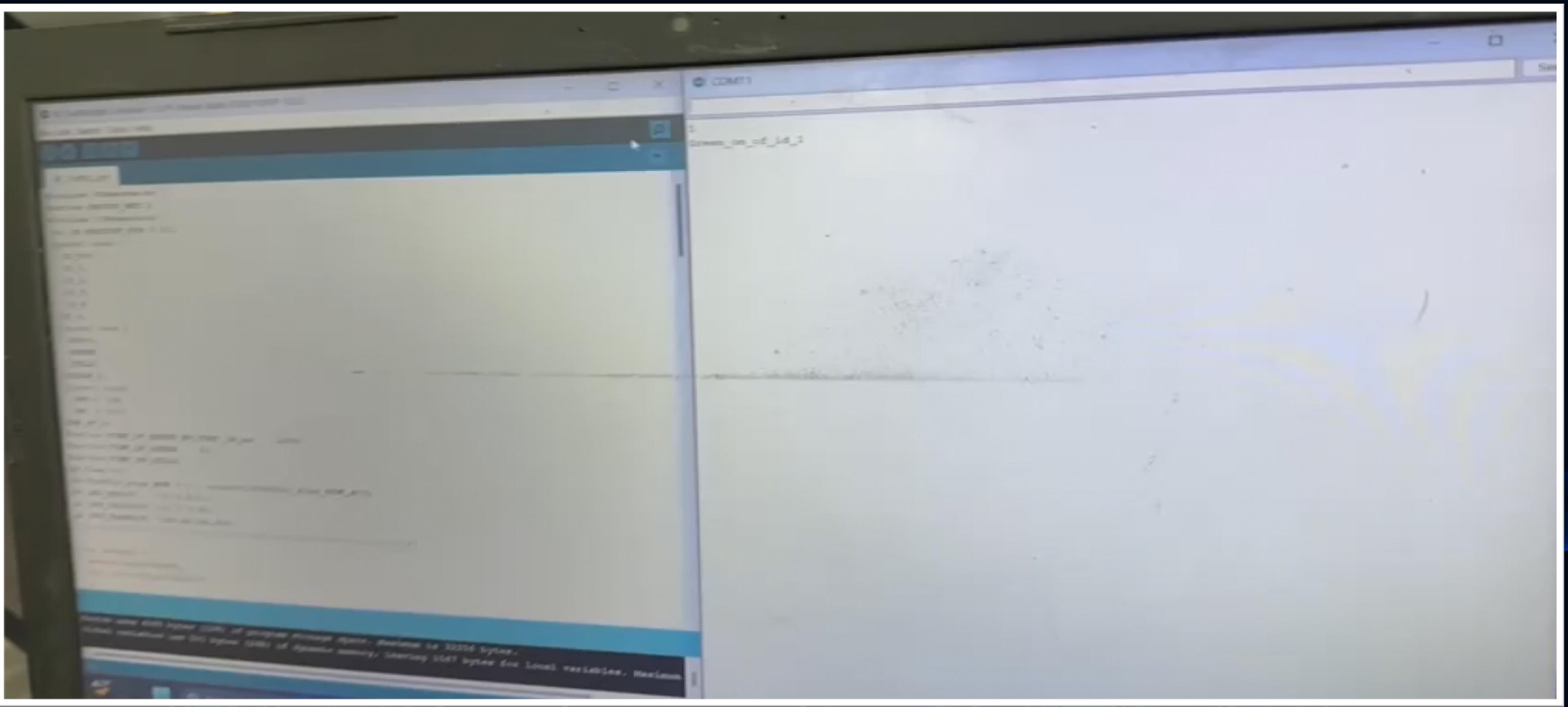
Traffic light system



Flowchart



Result : how traffic light works



Ambulance with traffic light

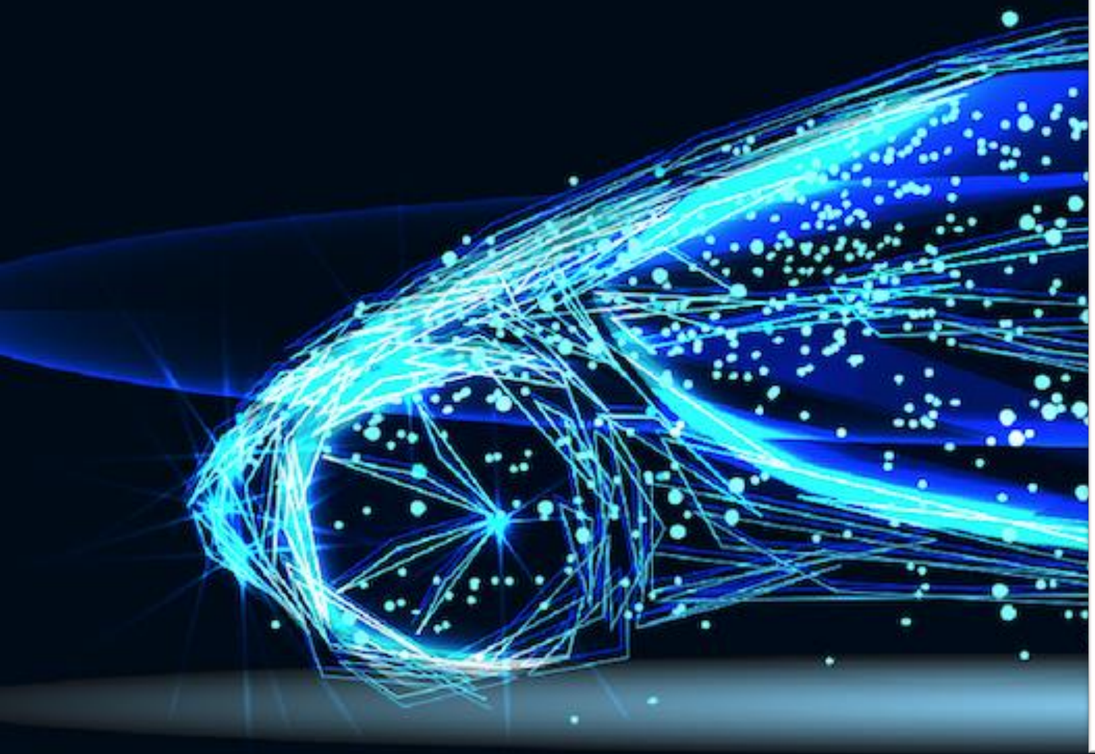
Why Emergency Response Times Matter ?

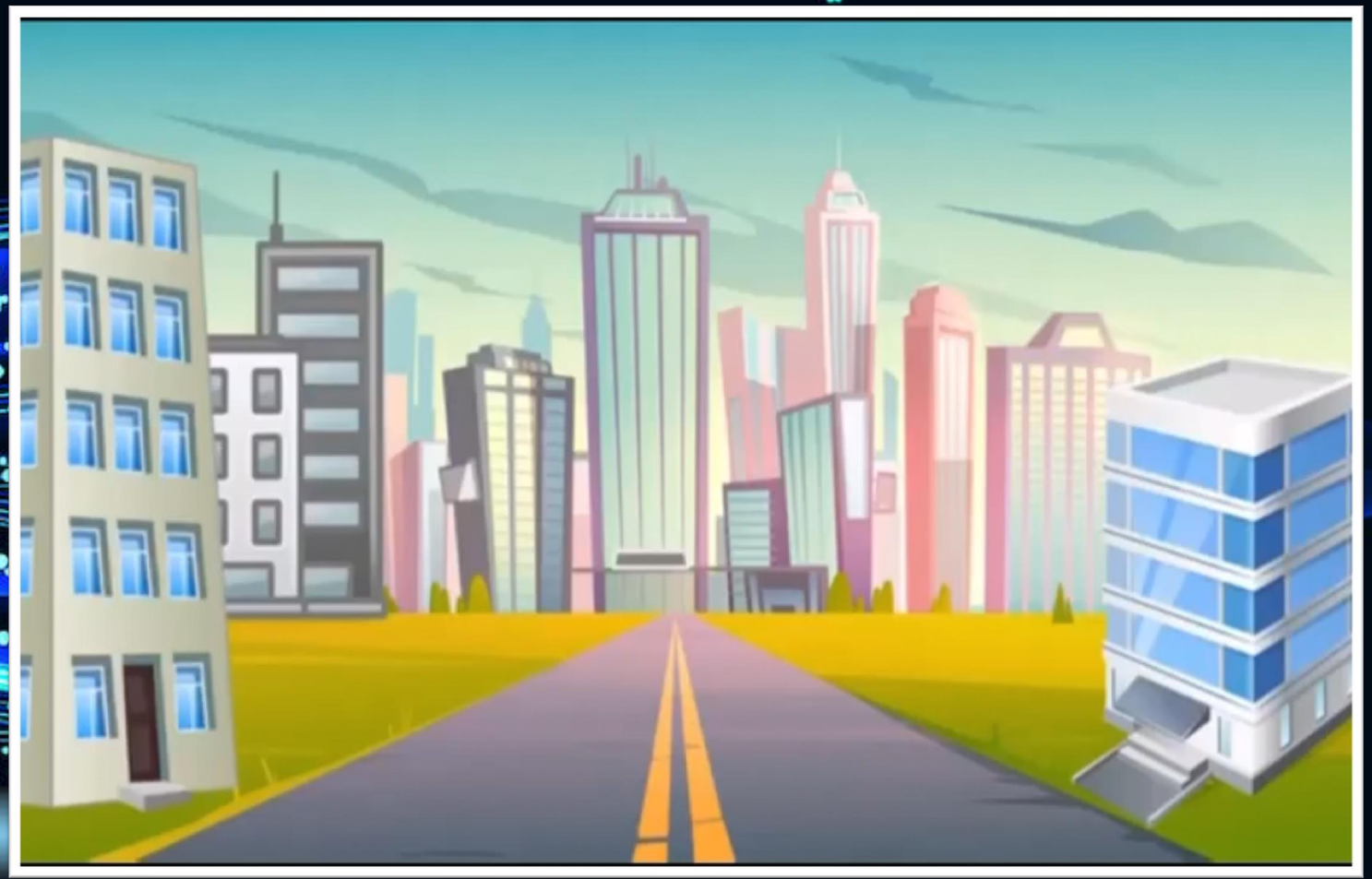
Emergency response times are critical for

1- saving lives

2- preventing injuries

3- minimizing damage



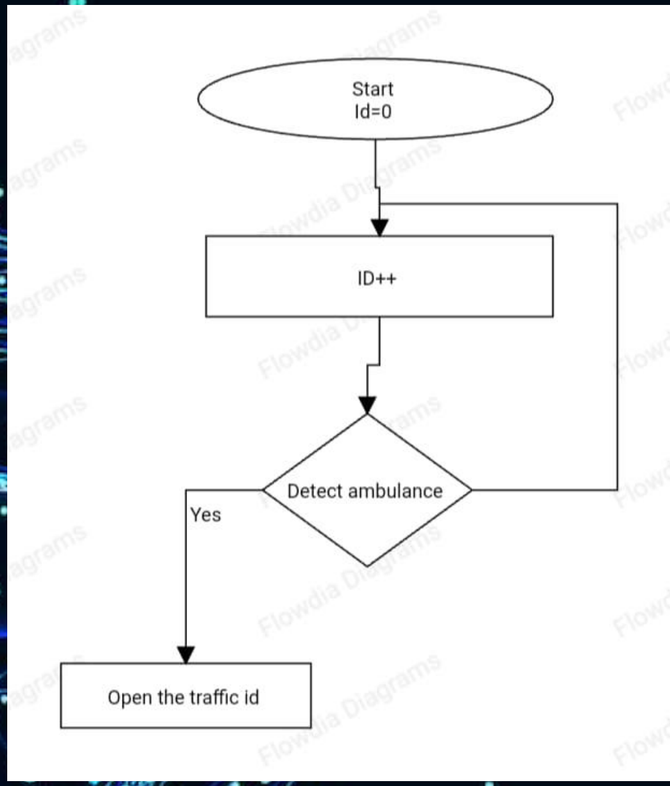


Ambulance with traffic light

1. How traffic lights with ambulance detection systems work:

A traffic light with ambulance detection is equipped with an (infrared or camera system)that can detect the approach of an ambulance.

When an ambulance is detected, the system can change the traffic light to green in the direction of the ambulance and red in all other directions, allowing the ambulance to pass through the intersection quickly and safely.



OUR PROJECT

After many researches, we found out that its for the best to add these three modes on our system

A. Using camera to detect the ambulance

Traffic lights with cameras can detect ambulances and prioritize their passage through the intersection, potentially saving lives by reducing response times. However.

Using communication technology

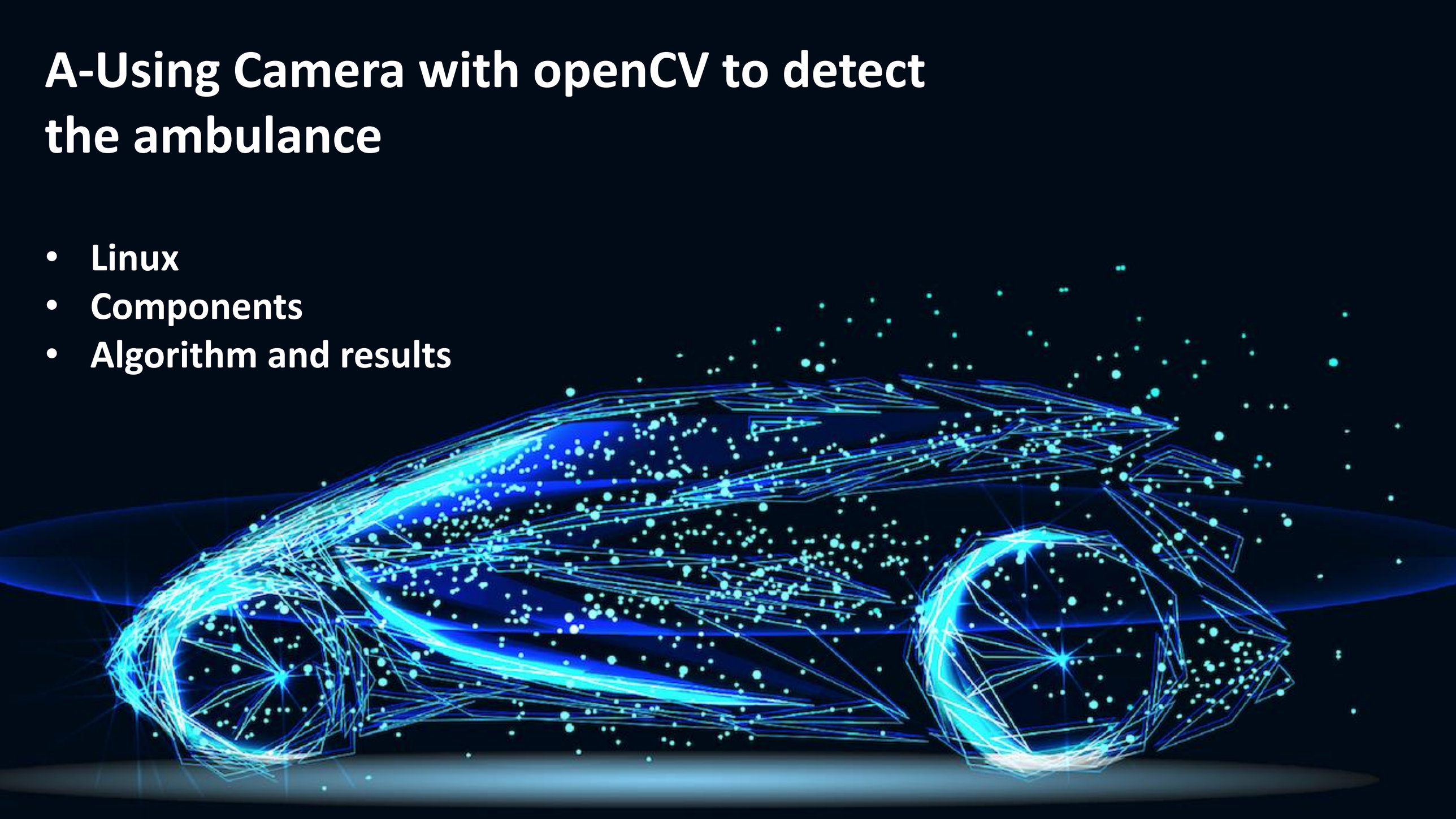
Traffic lights can use wireless communication technology to detect and prioritize emergency vehicles such as ambulances, potentially reducing response times and saving lives.

Connect between A & B

Link between two firs method to Improved Accuracy

A-Using Camera with openCV to detect the ambulance

- Linux
- Components
- Algorithm and results



Linux

What is Linux?

Free and open-source operating system based on the Unix operating system
Developed by Linus Torvalds in 1991
Key features: security, flexibility, customizability

Linux Kernel:

The Linux kernel is the core of the operating system and provides the basic services and functions that all Linux distributions share.
The kernel manages system resources such as memory, processors, and devices,
and provides a layer of abstraction between the hardware and the software.

Ambulance with traffic light (A)

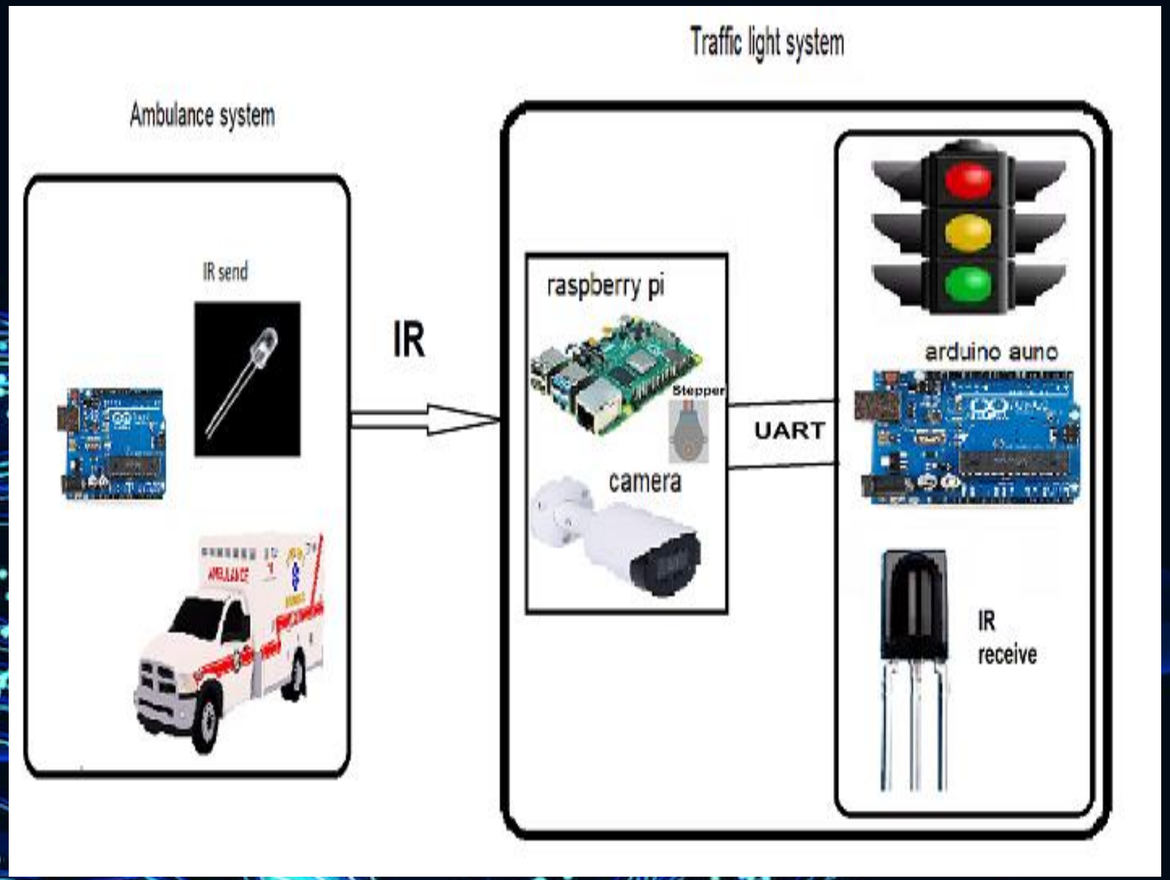
Components:

1.camera

2.Raspberry pi

3.Stepper motor

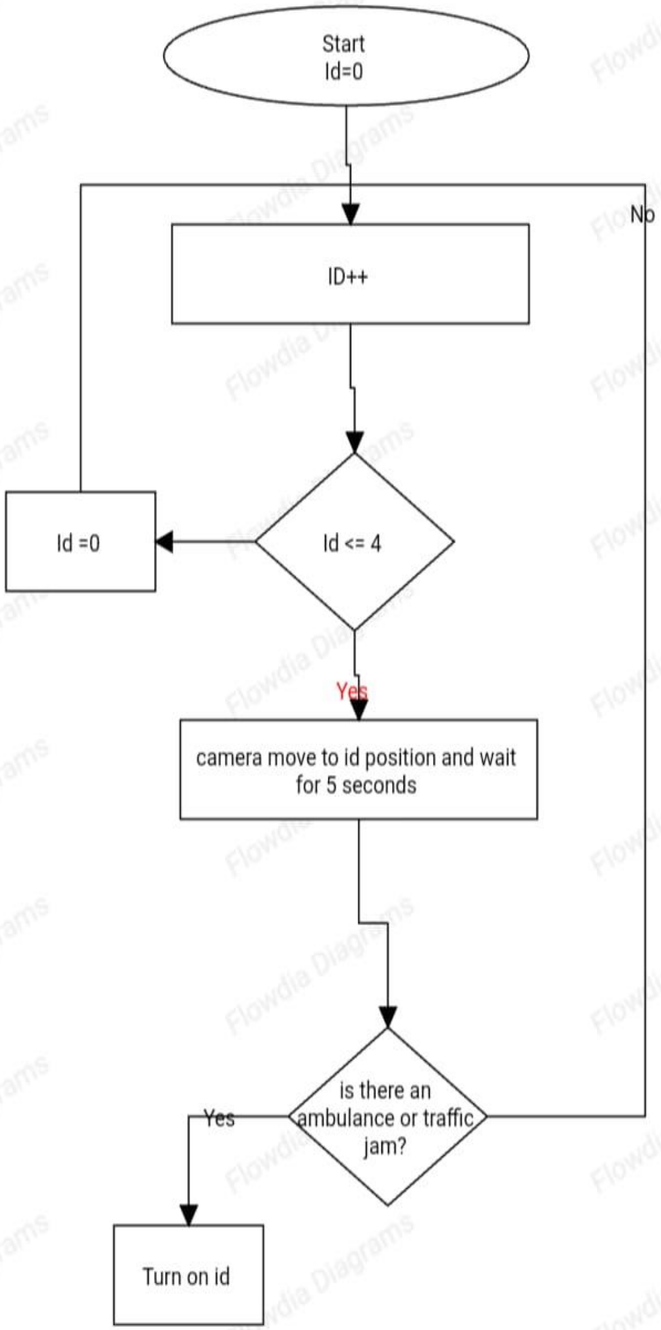
2. Arduino to control the traffic light



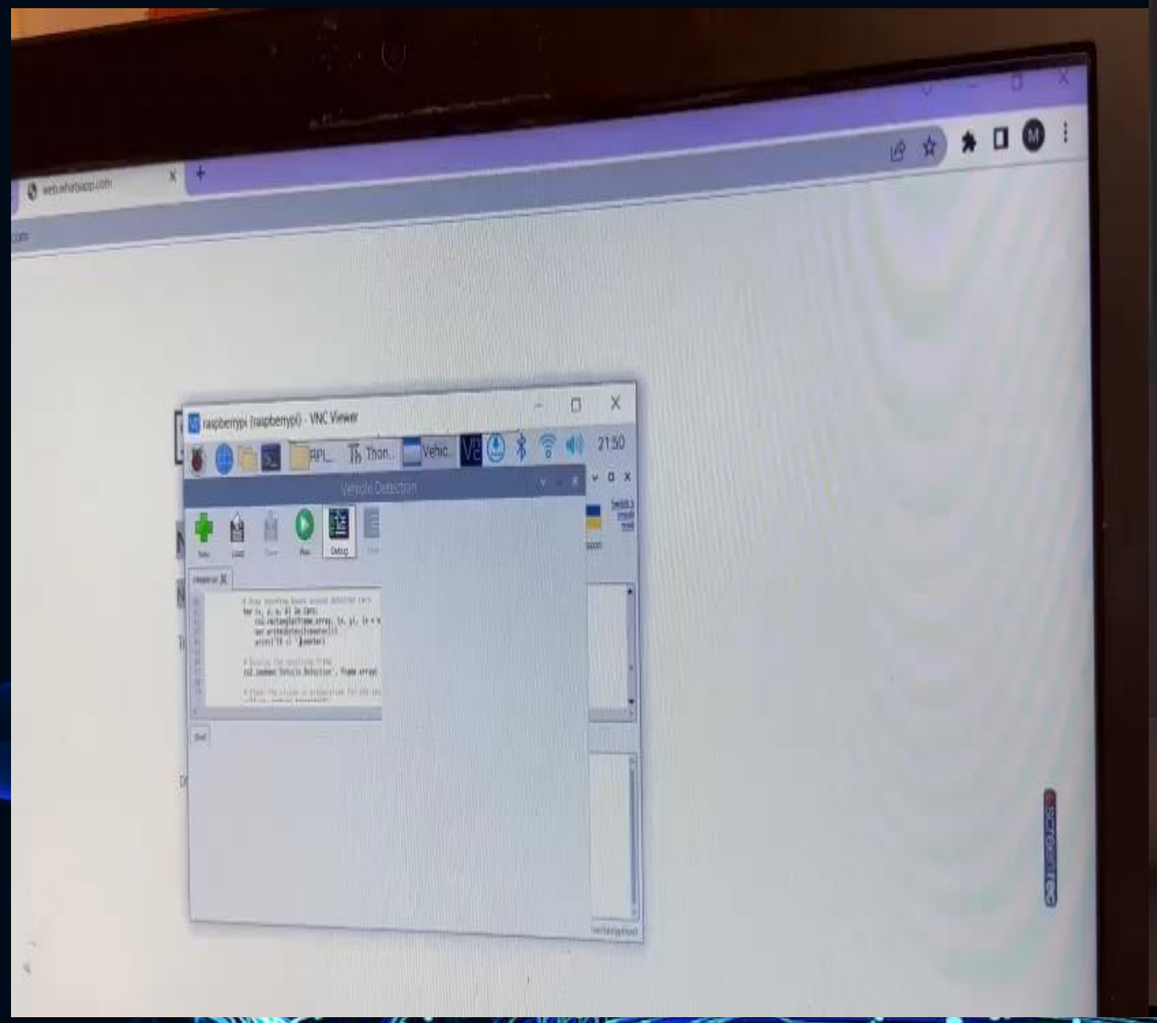
Algorithm

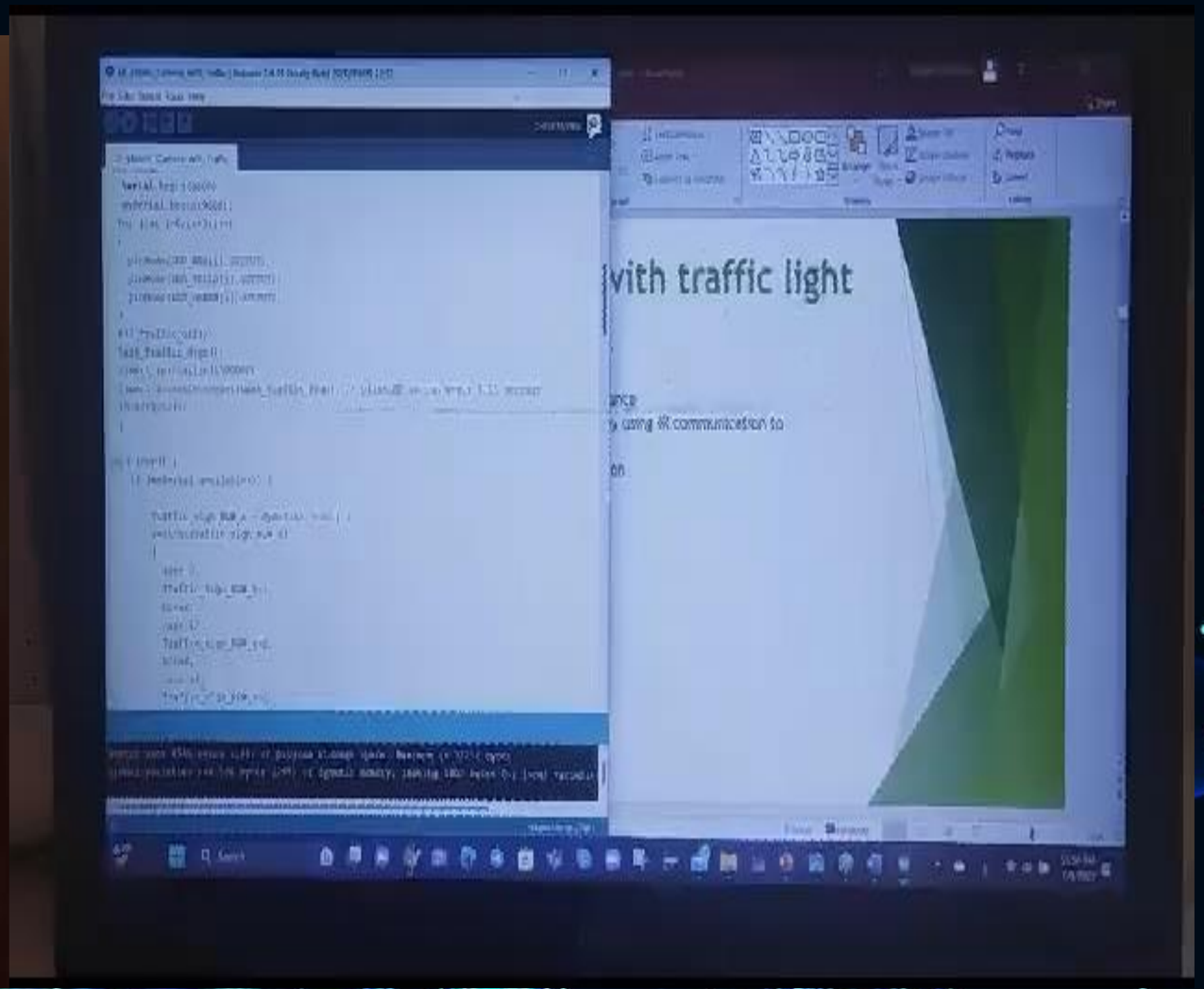
1-The camera will rotate on the roads to detect the location of the ambulance and send the data to the traffic signal control unit.

2- Then, the traffic signal control unit will start to clear the road for the ambulance.

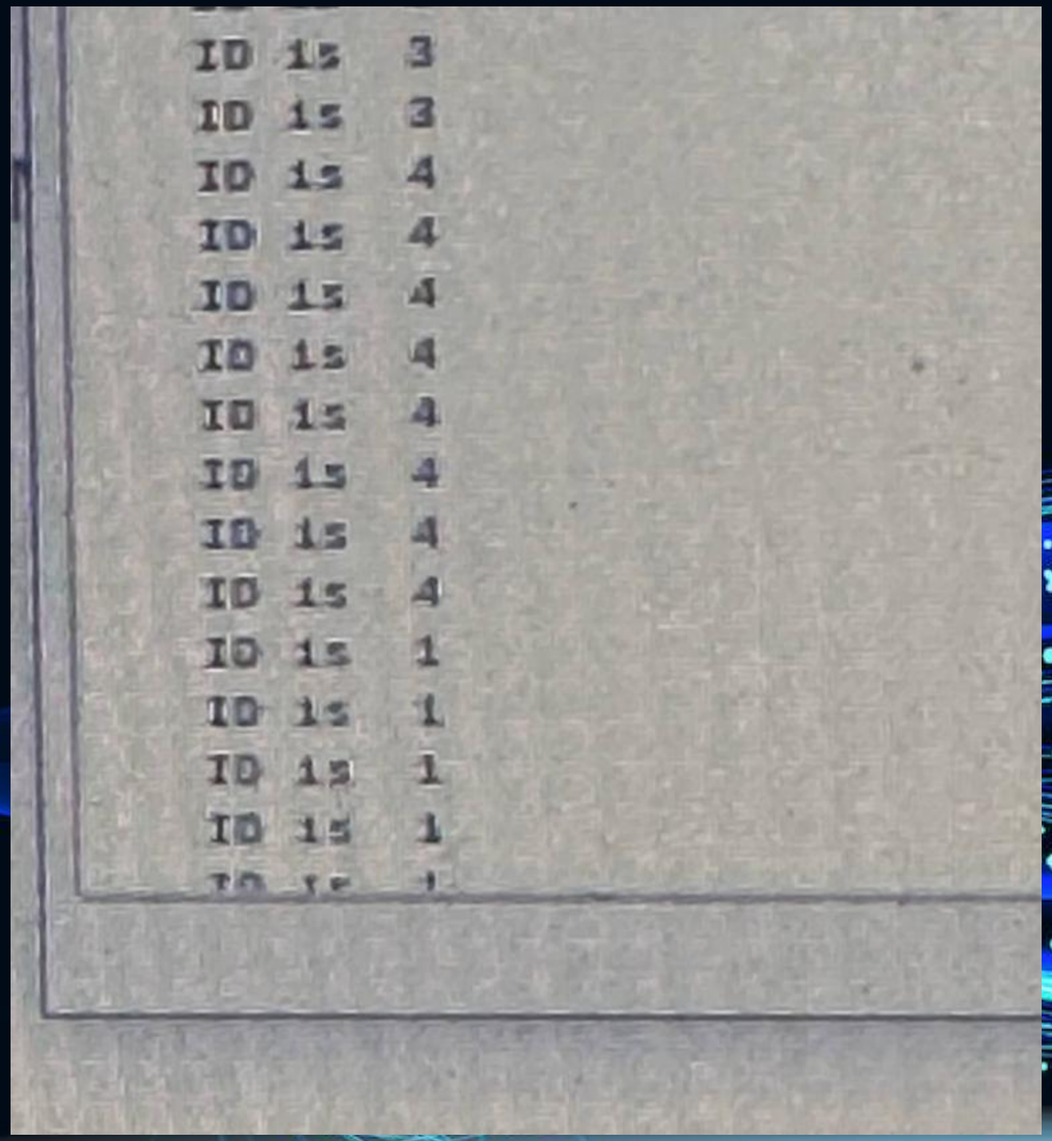


Prototype And Result





Result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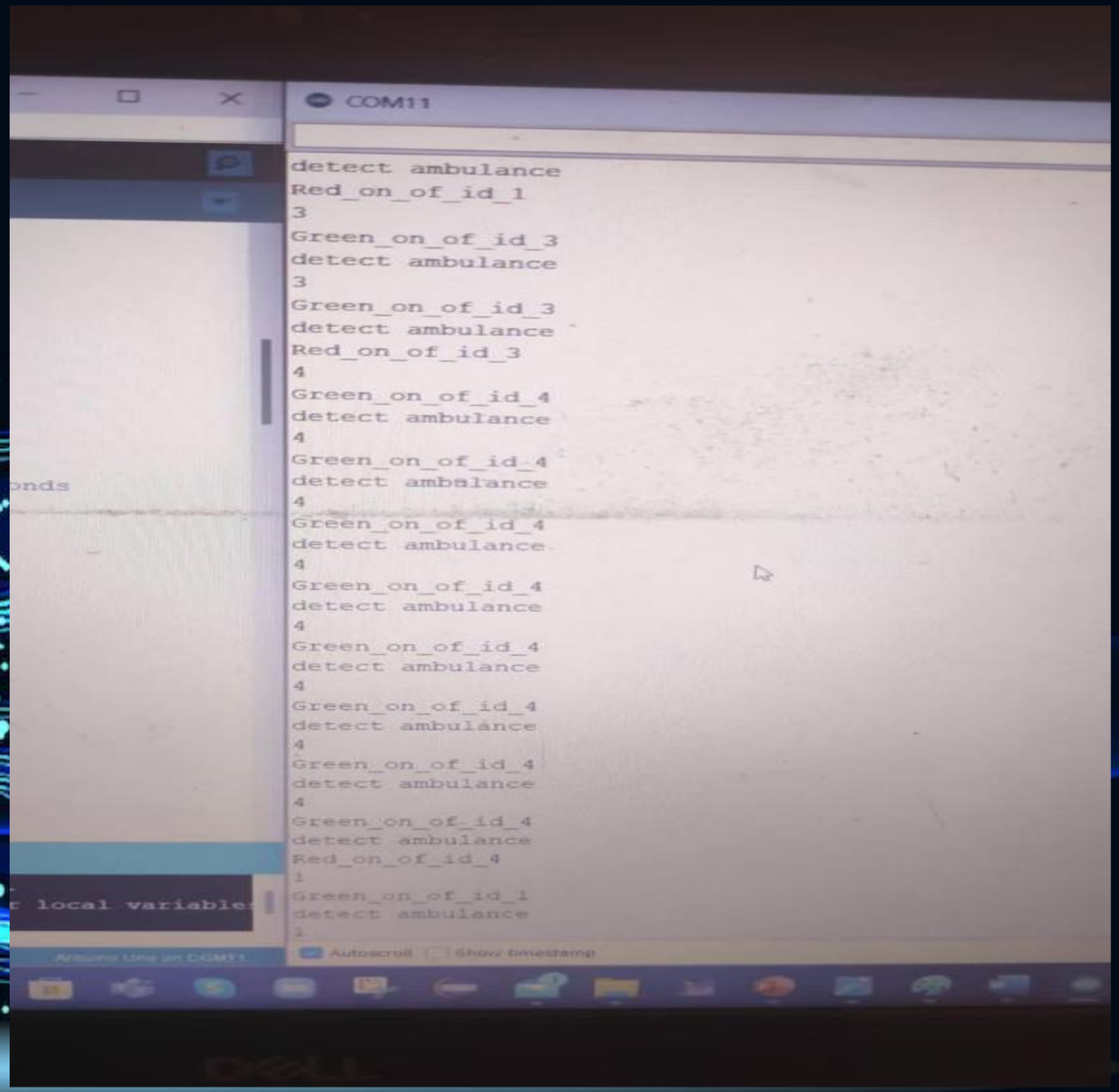
COM11
detect ambulance
Red_on_of_id_1
3
Green_on_of_id_3
detect ambulance
3
Green_on_of_id_3
detect ambulance
Red_on_of_id_3
4
Green_on_of_id_4
detect ambulance
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detect ambulance
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Green_on_of_id_4
detect ambulance
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Green_on_of_id_4
detect ambulance
4
Green_on_of_id_4
detect ambulance
Red_on_of_id_4
1
Green_on_of_id_1
detect ambulance
1
local variable
Autoscroll

B. Using communication technology

- Component
- Algorithm and result

Communication Technology comparison:

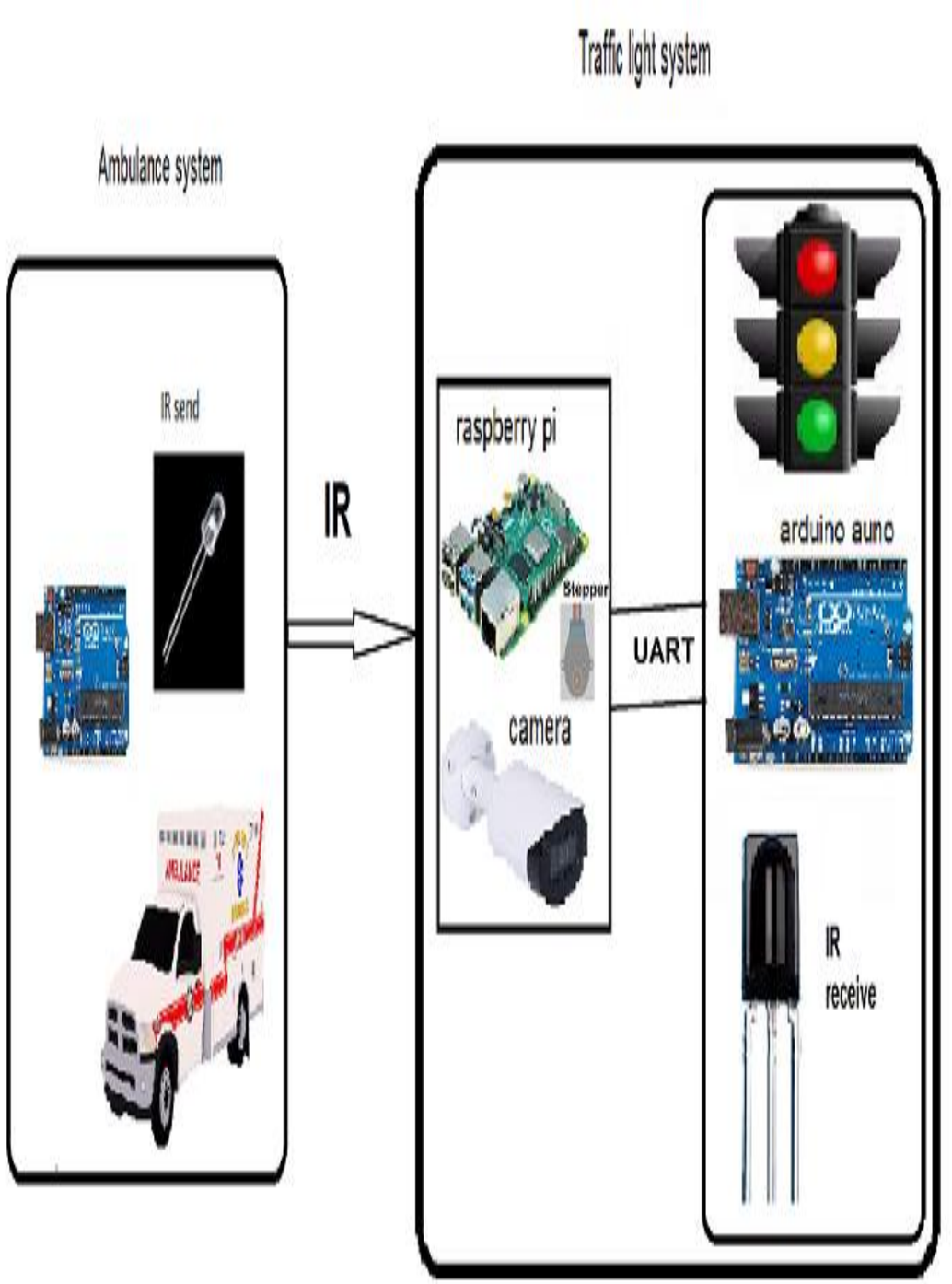
POC	**WIFI & Bluetooth**	**IR**
security	Less secure	more secure
power consumption	Higher	Lower
Simplicity of usage	Difficult	easy
range	Longer range up to 100 meters	Limited range 5 to 10 meters
data transfer rates	Faster	slower 115.2 Kbps (kilobits per second)
Cost	High	Low

We chose IR communication , as it meets out project’s criteria

Components:

1.IR send and IR receive

2. Arduino to control the traffic light

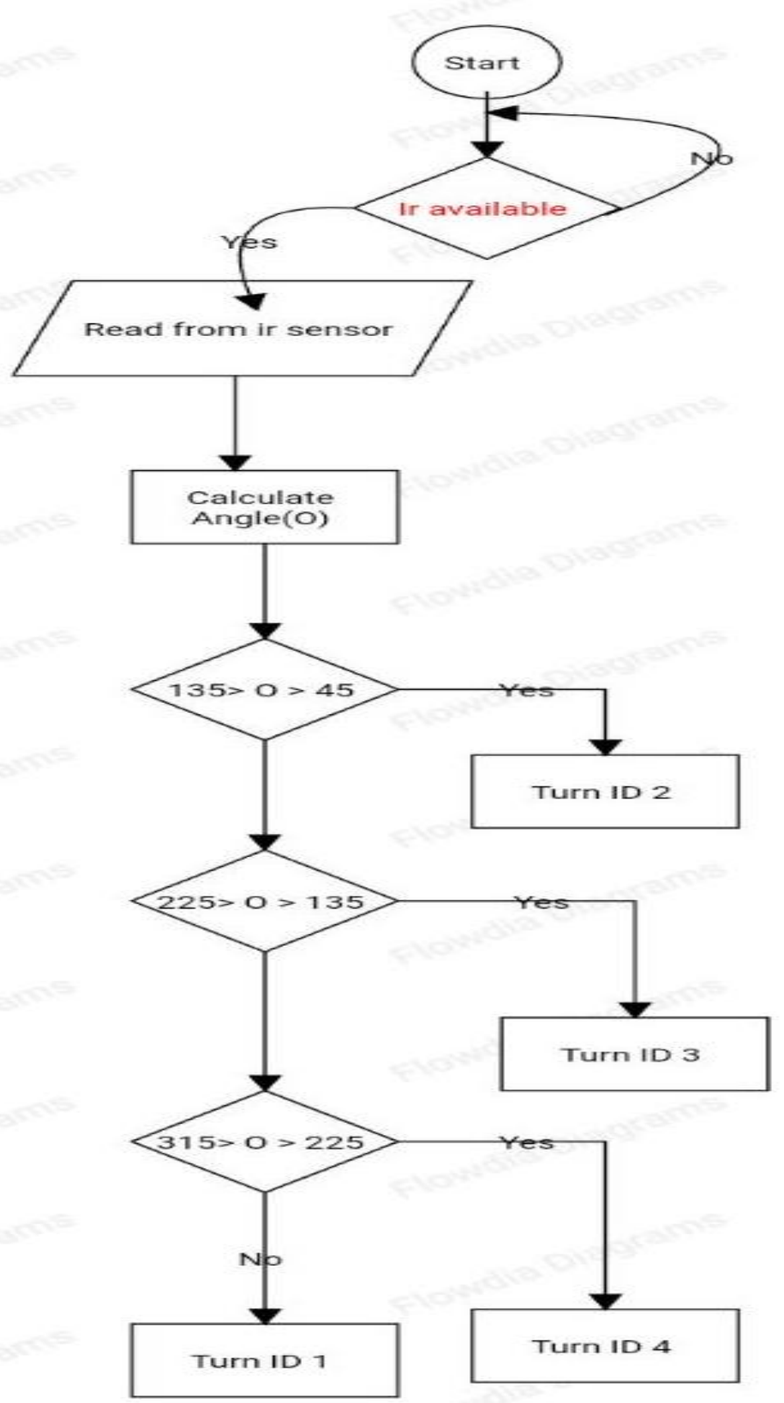


Algorithm :

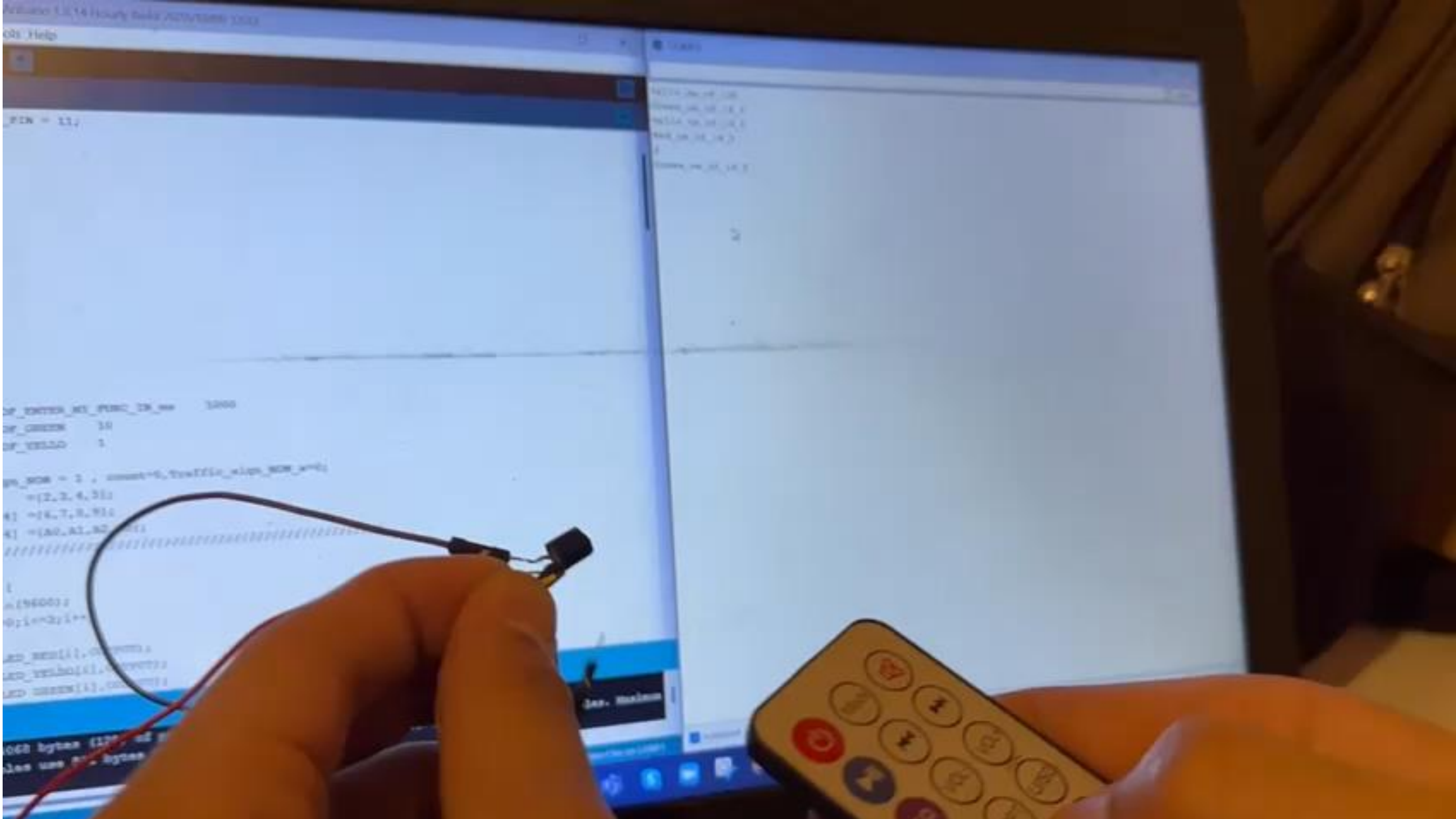
1.The traffic signal will operate as usual.

2.When the ambulance passes, its location data will be sent to the traffic signal through wireless communication.

3. Then, the street where the ambulance is located will be opened.



FIRE
RESCUE



C- Using camera with IR communication :

- Why did we connect between the two modes?
- Components
- Algorithm

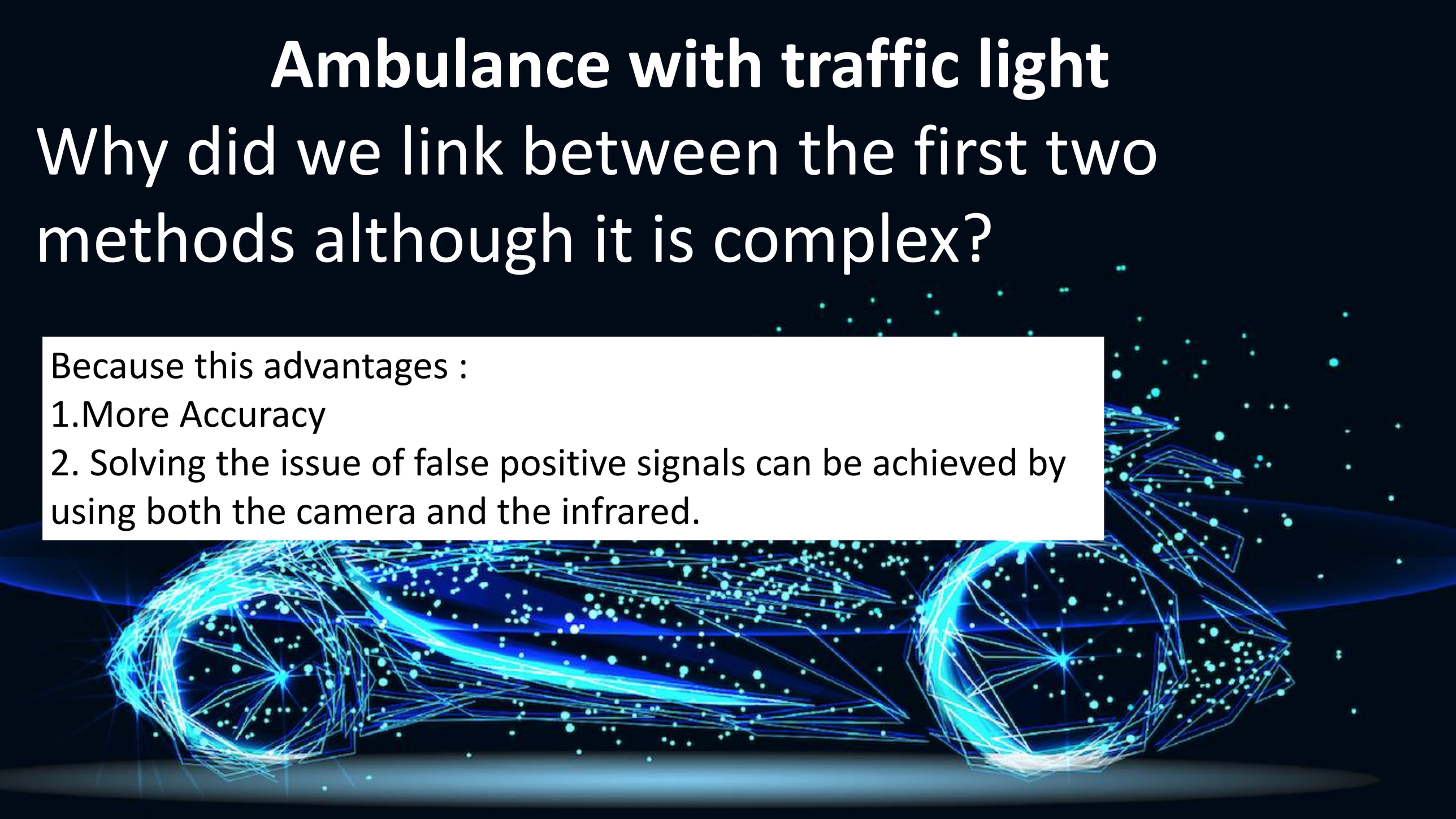
Ambulance with traffic light

Why did we link between the first two methods although it is complex?

Because this advantages :

1.More Accuracy

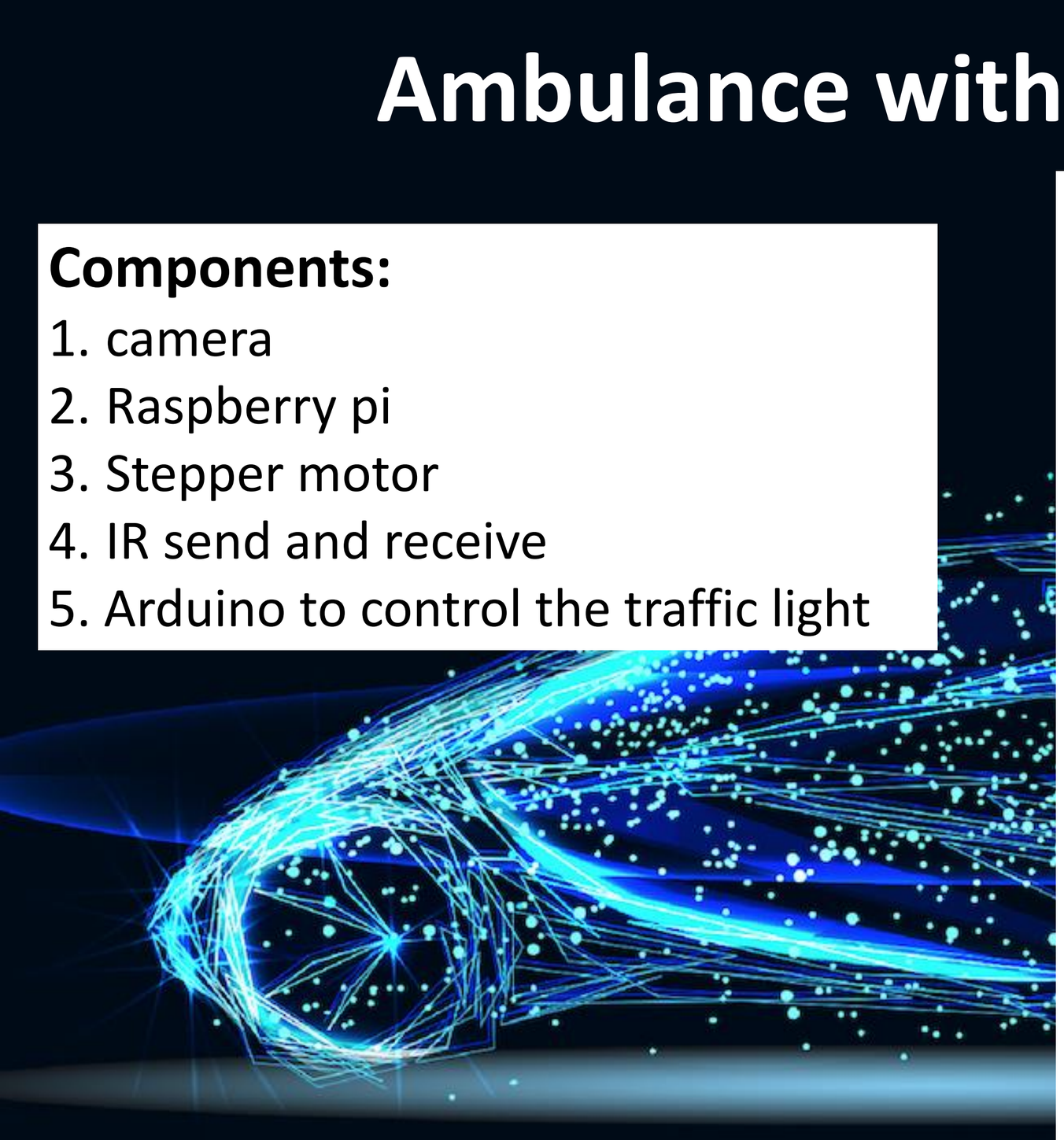
2. Solving the issue of false positive signals can be achieved by using both the camera and the infrared.

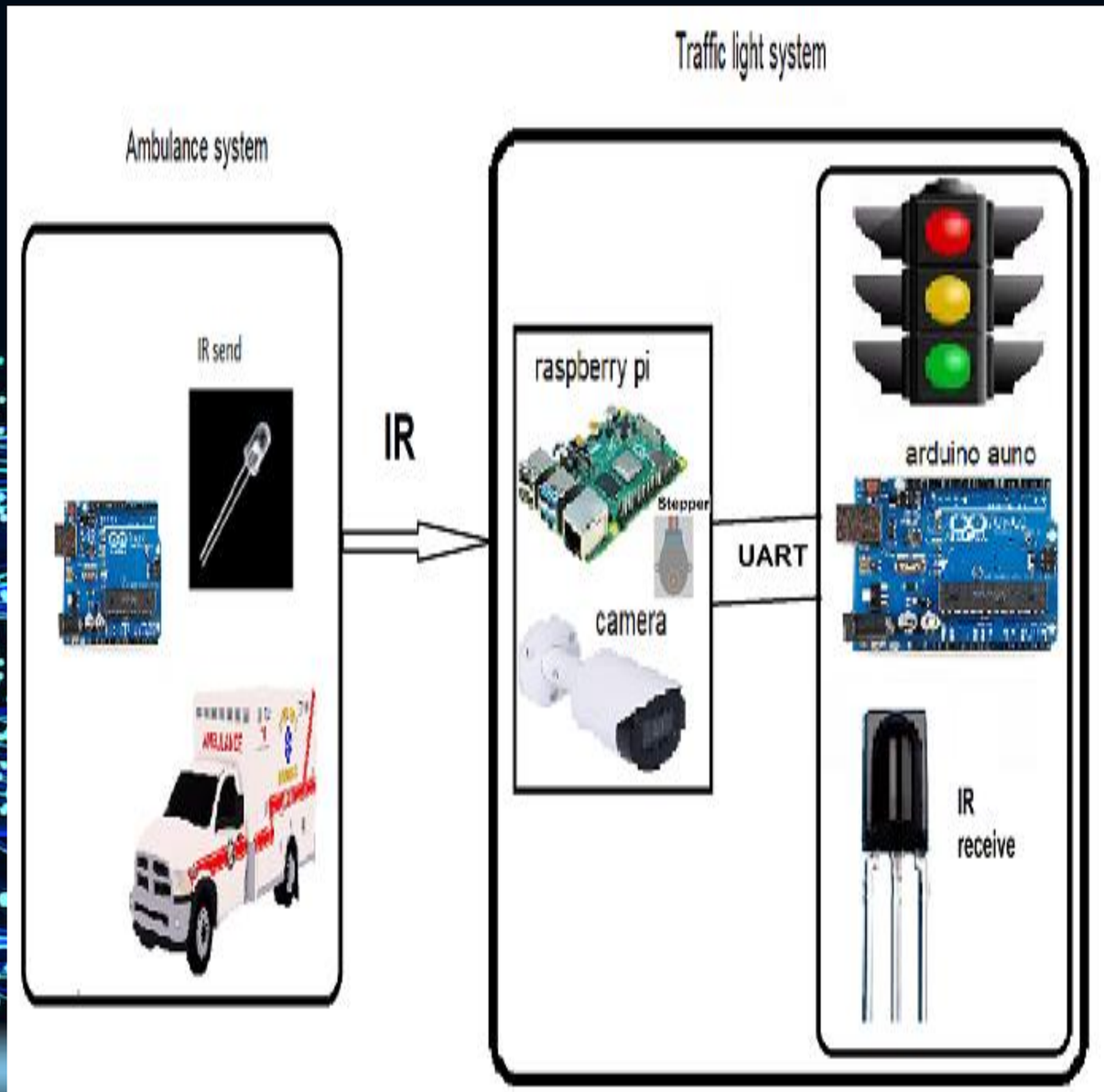


Ambulance with traffic light

Components:

1. camera
2. Raspberry pi
3. Stepper motor
4. IR send and receive
5. Arduino to control the traffic light





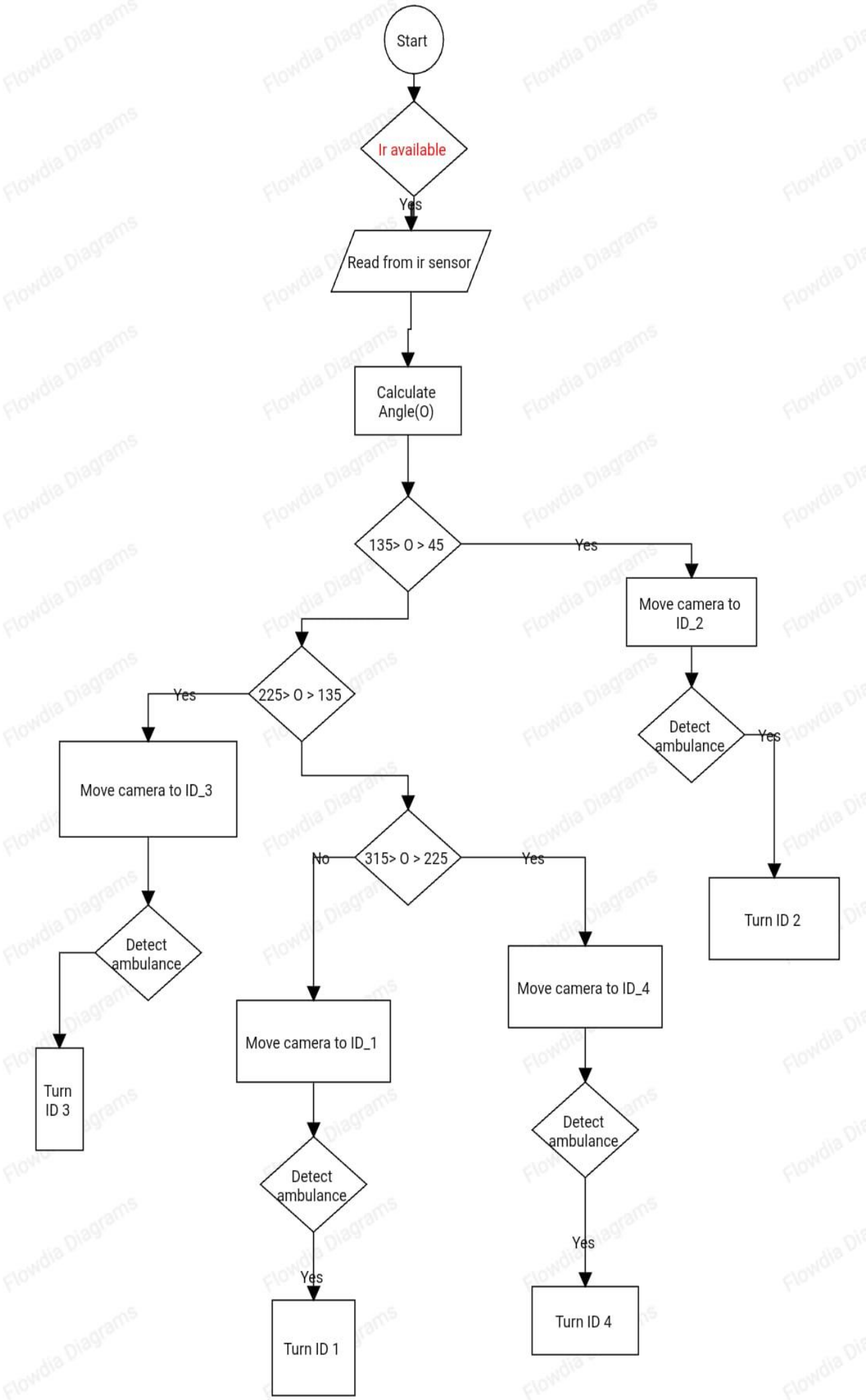
Algorithm

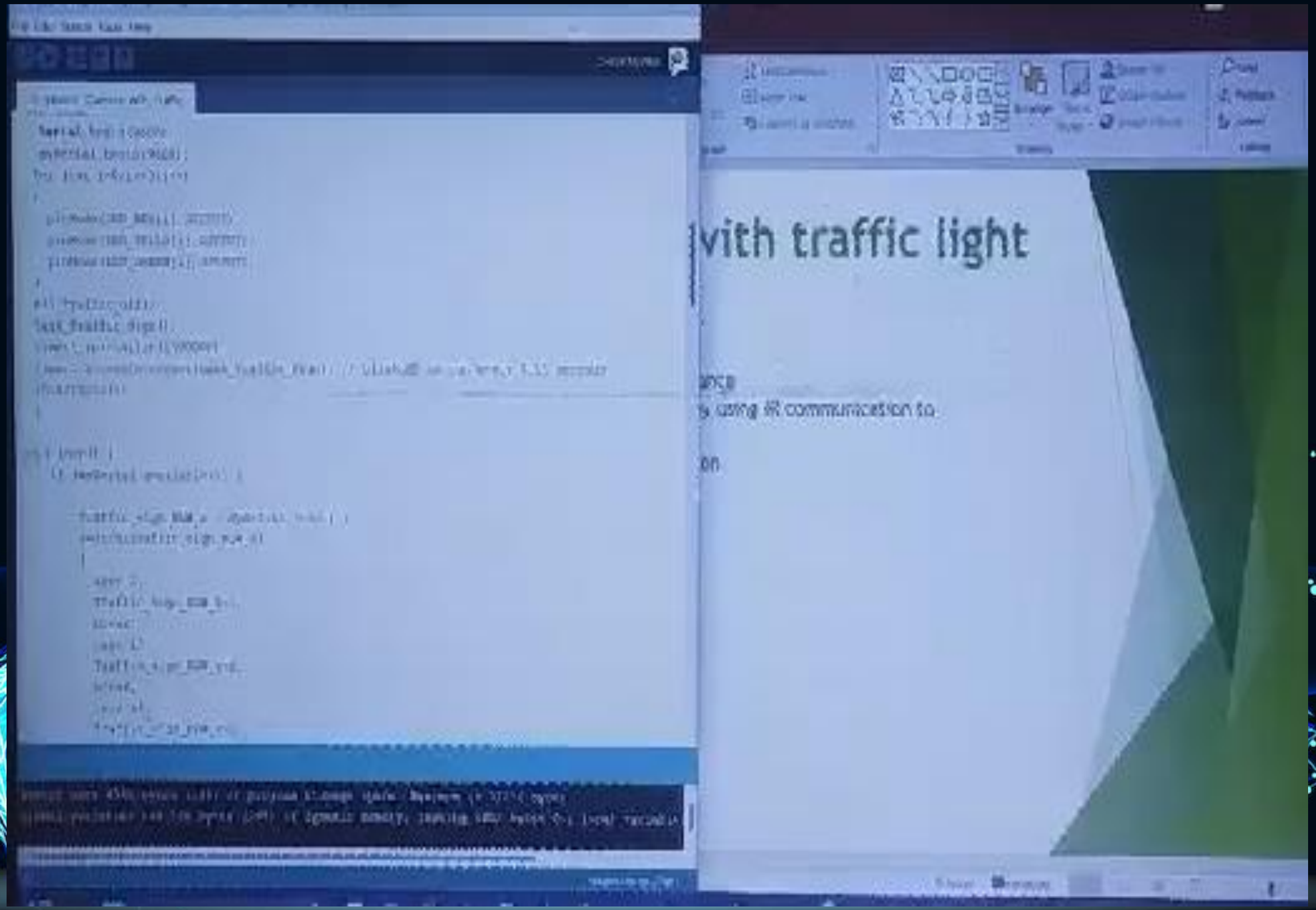
1. First, the location of the ambulance will be sent through wireless communication at a certain distance.

2. Secondly, this data will be taken and sent to the Raspberry Pi to verify that it is an ambulance using the camera.

3. Thirdly, when it is verified that it is an ambulance, the data confirming this will be sent.

4. Finally, the traffic signal control unit will unlock the other roads and close the road to the ambulance.




vith traffic light
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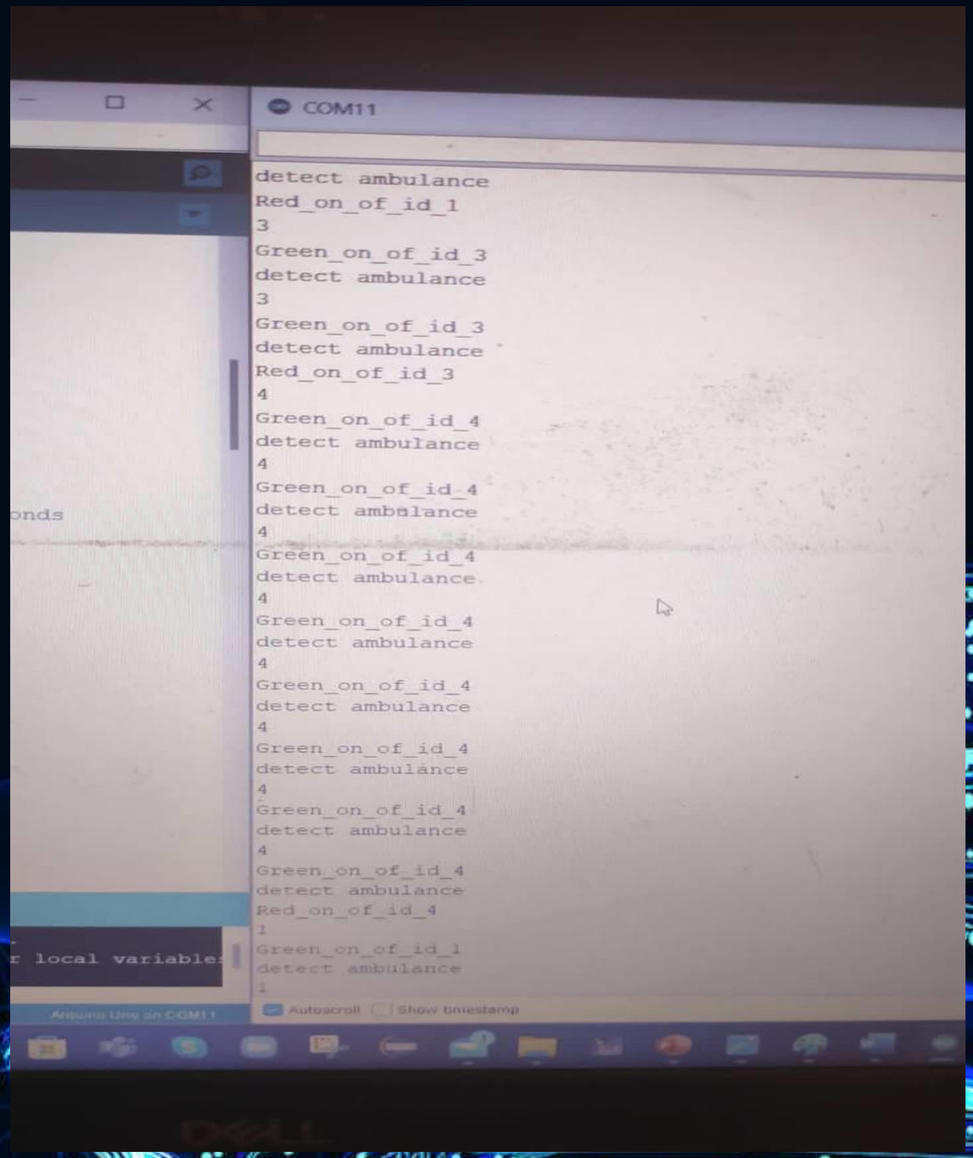
COM11
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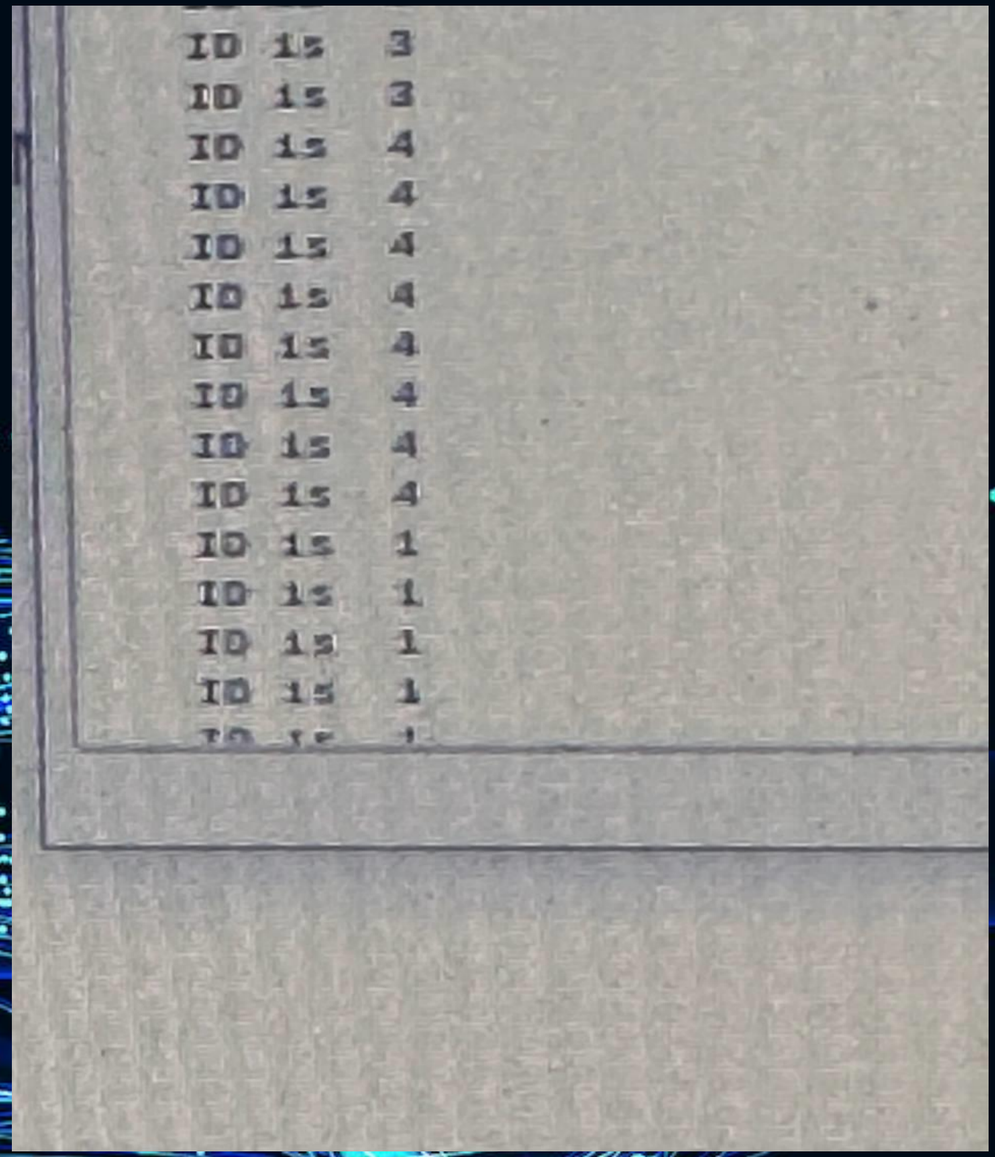
detect ambulance
Red_on_of_id_4
1
Green_on_of_id_1
detect ambulance
1
Autoscroll
Show timestamp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Ambulance with traffic light

Challenges and limitations:

a. False positive detection: The system may detect non-emergency vehicles as ambulances, leading to unnecessary traffic disruptions.
b. Maintenance: The infrared or camera system requires regular maintenance, including cleaning and calibration, to ensure that it functions properly.
c. Privacy concerns: The use of cameras in public spaces raises privacy concerns, and some people may object to being recorded without their consent.

Future Work:

1. **With the help of Google map its very easy to detect the Emergency Vehicle and find the shortest path.**

conclusion

1. This project has the potential to save the lives of people in emergency vehicles by allowing them to arrive at their destination faster.
2. The system could benefit the emergency department and also the government.
3. The basic idea of this system is to allow emergency vehicles to pass through the junction without congestion. The prototype can be improved by wireless technology in a real-life scenario.
4. Reduce traffic fatalities and injuries by providing advanced warning systems, automated braking, lane departure warnings, blind-spot monitoring, and more.

Mohammed Ramadan
Mohamed shaheen

Bahgat Mahmoud
Bahgat Ali

Abdullah Mohammed
Abdullah Zaki

Mariam Ahmed Saeed
Abd El-Ghafar

Amira Mahmoud
Badawy Mahmoud

OUR TEAM